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(54) **A door lock device, particularly for domestic electrical appliances**

(57) The device comprises:

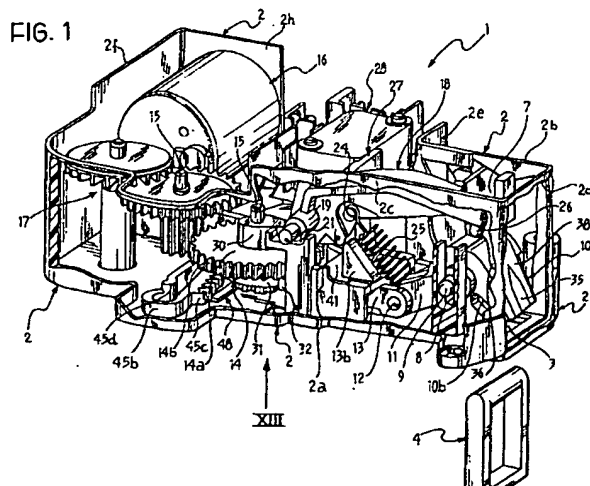
- a support structure (2) in which is defined an aperture (3) for the introduction in a predetermined direction of a door catch (4) connected to a door;
- a retainer member (10) movably mounted in the said structure (2) and having a seat (10) for receiving and retaining the door catch (4);
- a conditioning mechanism (11-13, 18, 25, 33) cooperating with the retainer member (10) and operable to assume

\* a first condition in which it allows en-

gagement of the door catch (4) with the retainer member (10) to retain the door in a closure position, and release of this coupling to allow opening of this door by application of a force on it; and

\* a second condition in which the retainer member (10) is maintained in a locked position in which it is able to retain the door in a locked closure position; and

- a motorised control device (14-17) associated with the conditioning mechanism and electrically operable to cause passage of this mechanism from the first to the second condition and vice versa.



## Description

**[0001]** The present invention relates to a door lock device, particularly for domestic electrical appliances such as washing machines and/or spin dryers.

**[0002]** One object of the present invention is to provide an improved door lock device having an extremely reliable operation.

**[0003]** This and other objectives are achieved according to the invention with a door lock device the main characteristics of which are defined in the annexed claim 1.

**[0004]** Other characteristics and advantages of the invention will become apparent from the following detailed description, provided purely by way of non-limitative example, with reference to the attached drawings, in which:

Figure 1 is a partly sectioned perspective view of a door lock device according to the present invention;  
Figure 2 is another perspective view of the door lock device of figure 1;

Figure 3 is a plan view from above of the door lock device according to the preceding figures;

Figure 4 is the sectioned view essentially taken on the line IV - IV of figure 3;

Figures 5 and 6 are partial perspective views of the device of the preceding figures;

Figure 7 is a perspective view similar to that of figure 5 and shows the door lock device in another operating condition;

Figure 8 is a sectioned view similar to that of figure 4, and shows the device in the operating condition of figure 7;

Figure 9 is a partial plan view from above, similar to that of figure 3 and shows the device in another operating condition;

Figure 10 is a sectioned view similar to that of figures 4 and 8, which shows the device in the operating condition of figure 9;

Figures 11 and 12 are partial perspective views similar to those of figures 5 and 6 and show the device in the working condition of figures 9 and 10;

Figure 13 is a partial view from below essentially in the direction of the arrow XIII of figure 1;

Figure 14 is a partial perspective view on an enlarged scale which shows a detail of the device of the preceding figures;

Figures 15 and 16 are partially sectioned views similar to those of figures 4, 8 and 10 and show a device formed as a variant embodiment in two different working conditions;

Figure 17 is a partial plan view from above similar to the views shown in figures 3 and 9 and shows a variant embodiment of the device according to the invention;

Figures 18 and 19 are partial perspective views of the device of figure 17;

Figures from 20a to 20f are six partial views essentially taken on the section line XX of figure 17, and show the device of figures from 17 to 19 in six different working conditions;

Figures 21 and 22 are two perspective views of a further variant embodiment of the door lock device according to the invention;

Figures 23 and 24 are perspective views of a further door lock device according to the invention;

Figures 25 and 26 are perspective views which show a cam member and an associated lever forming part of a door lock device of figures 23 and 24; Figure 27 is a plan view from below of a part of the device of figures 23 to 26;

Figure 28 is a plan view from above of the device of figures 23-27;

Figure 29 is a sectioned view on the line XXIX - XXIX of figure 28;

Figure 30 is a perspective view from below of part of the device of figures 23 *et seq*;

Figure 31 is a partial plan view from above, on an enlarged scale, of the device of figures 23 *et seq*;

Figure 32 is a view similar to that of figure 27;

Figure 33 is a view similar to that of figure 29 and shows the device of figures 23 *et seq* in a different operating condition;

Figures 34 and 35 are similar views to those of figures 30 and 31 respectively, and show the operating condition of figure 33;

Figure 36 is a view similar to those of figures 27 and 32 but relate to the operating condition of figures 33-35;

Figures 37 and 38 are views similar to those of figure 35 and 36 respectively, but refer to a further operating condition;

Figure 39 is a sectioned view similar to those of figures 29 and 33 and shows the device in an emergency release condition;

Figure 40 is a partial perspective view from below of the device in the condition of figure 39; and

Figure 41 is a partial view similar to those of figures 31, 35 and 37 and shows part of the device in the condition of figures 39 and 40.

**[0005]** In the drawings, and in particular in figures 1 and 2, a door lock device according to the invention is generally indicated 1.

**[0006]** The door lock device 1 comprises a support casing 2, for example of moulded plastics material, which is illustrated in partially sectioned form in figures 1 and 2. In the embodiment illustrated by way of example this support casing 2 has essentially a shaped bowl-like form, with a substantially planar bottom wall 2a. At one end of this bottom wall is formed an aperture 3 which, as will become more clearly apparent hereinafter, is intended to allow the introduction (into the casing or support structure 2) of a door catch 4 connected to a door (not illustrated) of a domestic electrical appliance.

[0007] With reference to figure 3, in the embodiment illustrated by way of example, the support casing 2, has in plan a substantially L-shape form with an essentially vertical major limb 5 joined to an essentially horizontal minor limb 6. The support casing 2 has a shaped side wall. In the minor limb 6 of the casing 2 this side wall comprises two facing, parallel wall portions 2b and 2c, joined together by a wall 2d orthogonal to them.

[0008] The limb 5 of the support casing 2 has a pair of facing walls 2e and 2f which are essentially rectilinear and which join with another pair of facing wall portions 2g and 2h having respective shapes.

[0009] The wall portions 2e and 2g join to the wall portions 2b and 2c respectively.

[0010] The aperture 3 for the introduction of the door catch 4 is formed in the bottom wall of the limb 6 of the support casing 2.

[0011] From the inner faces of the wall portions 2b and 2c of the support casing 2 extend respective formations which define facing rectilinear guide grooves 7 and 8, which extend in a direction essentially orthogonal to the bottom wall 2a.

[0012] A pin generally indicated 9 is mounted so as to be slidable along the guide grooves 7 and 8. On this pin 9 are rotatably mounted a retainer member generally indicated 10 and the two limbs of a fork end of a lever 11. The other end of this lever 11, also fork shaped, is articulated at 12 to a slide member generally indicated 13. This slide member (see in particular figure 4) is slidably mounted on the bottom wall 2a of the support casing for movement along a direction (horizontal as seen in figure 4) essentially orthogonal to the sliding direction of the pin 9.

[0013] The slide member 13 cooperates in use with a main control cam member 14 mounted rotatably about a fixed pin 15 which projects from the bottom wall 2a of the support casing 2.

[0014] The cam member 14 has an intermediate portion 14a (figure 4) in the form of a wheel, provided with peripheral teeth 14b.

[0015] In operation, as will become more clearly apparent hereinafter, the main control member 14 can be turned about the axis of the pin 15 by an electric motor 16 mounted in the casing 2 by means of a gear transmission generally indicated 17.

[0016] The electric motor 16 is for example a DC/AC electrical motor.

[0017] A retainer lever generally indicated 18 is intended to cooperate, in a manner which will be described hereinafter, with the retainer member 10.

[0018] From the end of the lever 18 furthest from the retainer member 10 extend, transversely from opposite sides, two essentially cylindrical formations 19 and 20 aligned with one another and functioning as fixed pins. The formation 19 is engaged with clearance in a seat 21, whilst the formation 20 is engaged in a relatively narrower seat 22 (see in particular, for example, figures 3 and 19).

[0019] The lever 18 is turnable relative to the support casing 2 both in an essentially vertical plane (for which see figure 4) and in an essentially horizontal plane (for which see figure 3).

5 [0020] A recess 23 in the intermediate portion of the lever 18 (figures 4 and 5) houses a transverse projection 24 on which is hooked a first end of a coil spring 25 the other end of which is hooked onto the pin 12.

[0021] The end of the lever 18 nearer the retainer member 10 has a lower feeler projection or pawl 26, intended to cooperate with control profiles of the said retainer member 10.

[0022] As better seen for example in figures 2, 3, 5 and 7, from the end of the lever 18 remote from the retainer member 10, adjacent to the transverse formation 20, extends a further transverse formation 27 the distal end of which is able to cooperate with a movable member of a microswitch 28 mounted in the support casing 2.

[0023] At the opposite side from the retainer member 10, the lever 18 has a terminal heel 29 (see for example figures 2 and 4). This heel 29 is intended to cooperate in use with an upper cam profile 30 of the main control member 14, having an eccentric shape with respect to the axis of the pin 15. The profile 30 is in fact the lateral surface of a formation integral with the member 14 which extends above the intermediate portion 14a of this member.

[0024] The member 14 has a further control profile 31, also eccentric with respect to the axis of the pin 15, on the opposite side from the profile 30 with respect to the intermediate portion 14a of the said member 14 (see for example figures 4, 8 and 13).

[0025] The control profile 31 of the cam member 14 is intended to cooperate in use with the slide member 13. In effect, as seen in particular in figures 4, 8, 10 and 13, the slide member 13 has a rear, convex, arcuate formation 32 intended to interact with the cam profile 31 of the control member 14.

[0026] As is partially illustrated in figure 6, the retainer member 10 is associated with a torsion spring 33 disposed around the pin 9. This pin tends to make the retainer member 10 rotate in the direction of the arrow 34 of figure 6.

[0027] The retainer member 10 has formations in relief on its periphery defining profiles with which the feeler projection 26 of the lever 18 cooperates in use. In particular, a first, essentially longitudinal projection formation 35 (figures 1-3 and 5) which is arcuate and convex, extends from the upper peripheral surface 10a of the member 10. The end of this formation 35 which faces the lever 18 has in plan a progressively tapered form, essentially in the shape of a wedge.

[0028] In longitudinally offset relation with respect to the projecting formation 35 the member 10 has a further projecting formation 36 having in plan a generally V-shape. Between the projecting formations 35 and 36 there is thus defined a channel of essentially of V or U-shape, indicated 37 (see in particular figures 5 and 7).

[0029] A further formation indicated 38 projecting from the retainer member 10 faces and is spaced laterally from the projecting formations 35 and 36.

[0030] In the direction of the lever 18 the projecting formation 38 of the member 10 extends beyond the projecting formation 36, as seen for example in figures 4 and 5, and forms an essentially radial projection indicated 38a.

[0031] A microswitch 39 is mounted in the casing 2 of the door lock device below and in an offset position with respect to the microswitch 28 (see in particular figures 2, 5 and 9).

[0032] The microswitch 39 has a movable control member indicated 39a in figures 3 and 9 controlled by a transverse projection 13a of the slide member 13.

[0033] As will become more clearly apparent below, the microswitch 28 is intended to provide in operation a signal indicative of the fact that the door or hatch of the domestic electrical appliance is in the closure position. The microswitch 39 is intended to provide a signal when this door or hatch is locked in the closure position.

[0034] The door lock device described up to now operates essentially in the following manner.

[0035] With the door open, the device assumes the rest configuration shown in figures from 1 to 6.

[0036] In this configuration the spring 33 (figure 6) maintains the retainer member 10 in an angular position in which it forms at the aperture 3 of the casing 2 a cavity or notch 10b intended subsequently to cooperate with the door catch 4 of the door of the domestic electrical appliance. The retainer lever 18 has its heel 29 disengaged from the cam profile 30 of the control member 14 (figure 4), the transverse projection 27 of this lever maintains the microswitch 28 in the condition in which it indicates the open condition of the door. The feeler projection 26 of the lever 18 (figure 5) presses against the end portion of the projecting formation 38 of the retainer member 10, at a distance from the projecting formations 36 and 35. A projection 38a of the retainer member 10 presses against an abutment formation 40 formed in the body 2 of the device (figures from 4 to 6). The slide member 13 has its rear tail 32 in engagement with the cam profile 31 of the control member 14.

[0037] In the embodiment illustrated this slide member 13 further has an upper projection 13b (figures 4 and 5) which presses against a transverse stop strip 41 mounted in the casing. The position of the retainer lever 18 in the horizontal plane is stabilised by the engagement of its lateral projection 42 (figure 3) in abutment against the lateral wall portion 2b of the casing 2.

[0038] The electric motor 16 is deactivated.

[0039] When the door of the domestic electric appliance is closed the door catch 4 of this door penetrates through the aperture 3 of the casing 2 of the door lock device 1 and with its distal portion engages in the hollow or notch 10b of the member 10 causing rotation thereof about the pin 9, which remains stationary relative to the casing 2. Upon rotation of the retainer member 10, an

inclined profile 36a of the projection 36 thereof engages the feeler projection 26 of the retainer lever 18 causing it to rotate in a clockwise sense as seen in figures 3 and 5 substantially with respect of the transverse pin 20 of this lever. Upon continuation of the rotation of the member 10, the feeler projection 26 slides along a longitudinal lateral edge portion 36b (figure 5) of the projection 36 until it penetrates into the channel 37 defined between the projections 36 and 35 (figures 7-9). The feeler projection 26 now engages in the manner of a pawl in the cavity in the projection 36 of the retainer member 10, best seen in particular in figure 7, in this way ensuring that the door of the domestic electrical appliance is retained in the closed position.

[0040] By the effect of the rotation described above the transverse projection 27 of the retainer lever 18 releases the activating member of the microswitch 28 which therefore provides a "door closed" signal.

[0041] In the above-described door closed condition, if the user presses the door of the appliance towards the door lock device 1 the door catch 4 causes a rotation of the retainer member 10, against the action of the spring 33, in such a way that the feeler projection 26 of the stop lever 18 extends into that part of the channel 37 situated to the right as seen in figure 5 and therefore leaves the channel 37, positioning itself in the region lying between the lateral projecting formation 38 and the projections 35 and 36. In this condition the biasing spring 33 brings the retainer member 10 into the rest position (figure 4) thus allowing reopening of the door. Once the door has been re-opened the door lock device reassumes the condition shown in figure 5.

[0042] If, on the other hand, in the door-closed condition (figures 7 and 8) the domestic electrical appliance is activated, the control unit of this apparatus causes activation of the electrical motor 16 of the door lock device 1 so as to cause rotation of the control member 14 via the gear transmission 17. The rotation of the control member 14 by means of the cam profile 31 causes translation of the slide member 13 in the direction of the aperture 3 and the door catch 4. This translation in turn involves a translation of the pin 9 of the member 10 along the guides 7 and 8 away from the aperture 3 by means of the interconnection lever 11, as seen for example by comparison of figures 10 and 8. Starting from the closure position of figure 8 the translation of the pin 9 and engagement of the lever 18 with the projection 36 of the member 10 causes rotation of this latter, in an anti clockwise sense seen in figure 8, until a shoulder 38b of the projection 38 (figures 11 and 12) engages with the abutment element 40 (see in particular figure 12).

[0043] The rotation of the control member 14 brings the cam profile 30 of this member into engagement with the heel 29 of the retainer lever 18 as shown in figure 10, so that the feeler projection 26 of this latter is disengaged from the projection 36 of the member 10.

[0044] The projection 13a of the slide member 13 engages the control member 39a of the microswitch 39

(figure 9) thus giving the "door locked" signal. The electric motor 16 is then deactivated, and the door lock device is now in the configuration of figures from 10 to 12.

[0045] The door can subsequently be released by making the electric motor 16 rotate in the opposite sense. Correspondingly, the control member 14 is caused to turn in the opposite sense from that previously. The slide member 13 now translates away from the door catch 4, and the pin 9 can translate along the guides 7 and 8 in the direction of the aperture 3, together with the retainer member 10 until the shoulder 38b of this member 10 is disengaged from the abutment surface 40. As soon as this happens, the biasing spring 33 associated with the member 10 causes rotation of this latter about the pin 9 towards the rest position which allows disengagement of the door catch 4.

[0046] If the electrical supply energy fails whilst the door lock device 1 is in the door closed and locked condition it is possible to effect a release or emergency re-opening of the door by means of a manual manipulation using the means which will now be described.

[0047] In figures 2 to 4, 8 to 10 and 13 a release member firmly mounted in the support casing 2 of the door lock device is generally indicated 45 and has an end 45a which extends out from this support casing.

[0048] The opposite end 45b of the release member 45 is essentially shaped as a hook and has a terminal portion 45c (figure 13) shaped as a rack capable of meshing with a toothing 46 coaxially and fixably associated with the main control member 14.

[0049] Conveniently the release member 45 is made of moulded plastics material and its rack-shape end portion 45c is moulded in a "closed" condition in such a way that in operation it tends elastically towards the adjacent link 45d of the release member (figure 13).

[0050] At the end part of the rack portion 45c of the member 45 is formed a projection 47 extending in the direction of the bottom wall 2a of the casing of the device, and intended in use to follow a predetermined path in a suitably shaped portion of the bottom wall 2a of the casing 2, generally indicated 48 in figures 1, 3, 9 and 14.

[0051] The release member 45 has two projections or transverse resilient arms 49, the distal ends of which rest against arcuate opposing surfaces 50 which converge in the direction of the end 45a of the member 45 (see for example figures 3 and 13).

[0052] The engagement of these resilient arms 49 with the opposing surfaces 50 is such as to resist the axial displacement of the release member 45 when a tension is exerted on its outer end 45a.

[0053] At rest the release member 45 is disposed as shown in figures 3 and 13 with its rack 45c adjacent to but disengaged from the toothed wheel 46 of the main control member 14.

[0054] To open the door in emergency conditions (for example in the case of a failure of the electrical energy whilst the door of the domestic electrical appliance is closed and locked) it is sufficient to apply a tension to

the member 45, as a consequence of which the rack 45c meshes with the toothed wheel 46 and then causes it to rotate. The cam profile 31 now performs a rotation of, for example, about 180° allowing the slide member 13 to translate away from the opening 3 and the from the door catch 4, in fact allowing the return of the whole door lock device to the rest condition in which opening of the door is permitted.

[0055] The projection or tooth 47 of the release member 45 extends inwards of a groove 51 of essentially P-shape, formed in the formation 48 of the bottom of 2a of the casing of the device (figure 14).

[0056] When the release member 45 is at rest, the tooth 47 engages in an end portion 51a of the groove 51: in this condition the rack 51c is in line with the toothed wheel 46 but is disengaged from it.

[0057] When the member 45 is subjected to a tension it translates, and the tooth 47 slides in an arm 51b of the groove 51 until it reaches a position indicated 51c in figure 14. Upon reaching this position, by the effect of the elasticity of the curved end 45b, the tooth 47 becomes displaced to a position indicated 51d in figure 14, ahead of a further longitudinal link 51e of the groove 51.

[0058] As soon as the release member 45 is released, its resilient arms 49 spring back towards the rest position: in this displacement the tooth 47 slides along the arm 51e of the groove 51, the bottom wall of which progressively rises until reaching the connection with the link 51b and the terminal of portion 51a of the said groove. The link 51e of the groove joins the terminal portion 51a forming a small descending step 51f. The vertical surface of this step now serves to subsequently guide the tooth 47 until it enters into the link 51b of the groove 51 upon subsequent actuation of the release member 45.

[0059] In figures 15 and 16 there is illustrated a variant embodiment which allows the performance of a further security function (the so-called "child-safety" function). Briefly, in the variant according to figures 15 and 16 it is preferable, when the door is closed but not locked, to be able again to open the door by means of the application to it of a force (greater than a predetermined value) from the inside towards the outside.

[0060] In the variant of figures 15 and 16 the transverse stop element 41 is an elastically deformable blade in the form of a leaf spring fixed at its ends.

[0061] The stop element 41 serves as an abutment element for the projection 13b of the slide member 13, in particular when the door is closed but not yet locked as is shown in figure 15. In relation to this figure, it can be seen that in the variant being described the cam profile 31 of the control member 14 is modified (compare figure 15 with figure 18) in such a way that between the rear tail 32 of the slide member 13 and this cam profile there is now defined a distance indicated a in figure 15. Between the top of the projection 13b of the slide member 13 and a corresponding prominence 18d of the hook lever 18 there is likewise defined a distance indicated b

in figure 15.

**[0062]** If, whilst the door is closed but not locked (figure 15), this door has a force applied to it in the opening direction, the retainer member 10 translates towards the walls 2a of the casing, and, via the lever 11, causes a translation of the slide member 13 in the direction of the control member 14, against the action of the resilient stop member 41 which is flexed. The device now goes into the condition shown in figure 16, in which the feeler projection 26 of the retainer lever 18 disengages itself from the retainer member 10, allowing this latter to rotate (in the clockwise sense as seen in figure 16) so as to release the door catch 4 and permit the door to open.

**[0063]** In figures from 17 to 20 is shown a further variant embodiment of a door lock device according to the invention. In these figures the parts and elements already described are again allocated the same reference numerals.

**[0064]** The variant according to figures from 17 to 20 differs essentially by the different disposition and configuration of the interacting parts of the retainer lever 18 and the member 10. In particular, with respect to the embodiment previously described, the interacting parts are now found on two facing surfaces of the lever 18 and the retainer member 10 respectively. Moreover, in the variant according to figures from 17 to 20 it is the member 10 which has a feeler projection 126 which cooperates with projections and profiles pre-arranged in a lateral face of the retainer lever 18.

**[0065]** These relieving and profiles are visible in part in figure 19 and in more detail in the various views of figure 20.

**[0066]** With reference in particular to figure 20, in the face of the lever 18 facing the retainer member 10 are in particular formed two projection 135 and 136 together defining a V-shape channel and functionally corresponding to the projections 35 and 36 of the previously described embodiment.

**[0067]** In the rest configuration (door open) the device according to the variant now being described is as is shown in figures 18, 19 and 20a: the end 18e of the retainer lever 18 presses against the feeler pin 126 of the member 10. In this condition the door can be closed by the introduction of the door catch 4 through the aperture 3 and then into the cavity 10b of the member 10 (figure 20a). Further closing displacement of the door causes rotation of the member 10 about the pin 9, still stationary with respect to the support casing 2 of the door lock device. The rotation of the retainer member 10 causes the retainer lever 18 to rotate by means of the feeler pin 126.

**[0068]** When the door has reached the closure position the door lock device is as shown in figure 20d: the pin 126 is disposed and retained in the cavity of the projection 136. In this case, before the door is locked in the closure position - after activation of the electric motor 16 - this door can again be opened, by means of a thrust exerted on the door or by means of a tension exerted on it as is shown in figure 20e and 20f respectively.

**[0069]** For the rest, all the possibilities and subsidiary functions of the versions previously described are also certainly achievable in the embodiment shown in figures 17 to 20.

**[0070]** A further variant embodiment is shown in figures 21 and 22.

**[0071]** In these figures, too, the parts and elements already described have been again allocated the same reference numerals as previously used.

**[0072]** In the embodiment of figures 21 and 22 the electric motor 16 of the door lock device is a unidirectionally rotatable AC motor. Correspondingly, the main control member 14 rotatable on the pin 15 has a further cam profile which is followed by a feeler member 61 mounted rotatably about an axis 62. The feeler member 61 is connected to a movable contact member 63 having one end stably connected to a first electrical terminal 64 accessible from outside and the other end capable of commuting (by the effect of the displacement of the feeler 61) between two extreme positions shown in figures 21 and 22 respectively, in which they are found in contact with a first and a second conductor member respectively, clenched onto corresponding terminals 65 and 66 also accessible from outside.

**[0073]** Between the movable contact 63 and the feeler member 61 is interposed a coil spring 67 which tends to press this feeler member into engagement with the cam profile 60 of the rotatable control member 14.

**[0074]** The cam profile 60 has in particular a notch 68 in which the tip of the feeler member 61 can engage when the door is closed but not locked. In this condition the movable contact 63 (figure 2) connects the terminals 64 and 65 together.

**[0075]** The cam profile 60 further has a projection 69 (figure 22) with which the tip of the feeler member 61 engages when the door is closed and locked. In this condition the movable contact 63 connects the terminals 64 and 66 together.

**[0076]** The cam 60, the feeler 61, the movable contact 63 and the terminals 64 to 66 overall constitute a sort of position sensor which makes it possible to indicate to the control unit the instantaneous condition of the door (open, closed, closed and locked, intermediate position).

**[0077]** The door lock according to figures 21 and 22 does not therefore have the microswitch 29 of the versions of the preceding figures.

**[0078]** For the rest, the device according to figures 21 and 22 can also conveniently include the components, and be arranged to performed the functions of the previously described versions.

**[0079]** In figures 23 and those which follow is described a further variant embodiment of the device according to the invention. In these figures, too, the parts and elements already described are again allocated the same reference numerals as previously utilised.

**[0080]** The device according to figures 23 *et seq* is in most respects rather simpler than that of figures 21 and

22 from which it differs essentially in the aspects which will now be described.

[0081] The device according to figures 23 *et seq* also comprise a single microswitch 28, and a position sensor device associated with the main control member 14 and including a cam profile 60 (see for example figure 29) with which cooperates a feeler member 61 connected to a movable conductive control member 63. This latter is stably connected to an electrical terminal 64, and is selectively commutable between the other two electrical terminals indicated 65 and 66. The cam profile 60 is similar to that already described above with reference to figures 21 and 22.

[0082] In the embodiment of figure 23 *et seq* the device has a further electrical connector terminal 70, accessible from the exterior (see for example figures 28 and 31).

[0083] Between the terminals 64 and 70 is disposed a tablet resistor 71 of positive temperature coefficient (PTC) type. One end of a bimetallic strip 72 is connected to the terminal 64 adjacent to this resistor 71.

[0084] A control member associated with the cam control member 14 is indicated 73 and rotatably mounted in the support casing 2 of the door lock device about an axis indicated 74 (see for example figures 28 and 31).

[0085] Generally, the control member 73 is essentially a lever having an L-shape rotatable about the axis 74 which passes through one end thereof. The free end of the bimetallic strip 72 is engaged in a notch 75 the other end of this lever.

[0086] In the device according to figures 23 *et seq* (as also in the device of figures 21 and 22) the cam 60, feeler 61, the movable contact 63 and the terminals 64 to 66 of the assembly, also constitute a position sensor which makes it possible to indicate to a control unit the instantaneous condition of the door. It is seen, however, that with respect to the version of figures 21 and 22, in the device according to figures 23 *et seq*, the cam 60 is disposed upon the lower face of the main controller 14 (see for example figure 24 or figure 40).

[0087] In its intermediate portion the control member 73 has a shaped through hole 76, through which the upper end of the pin 15 extends with clearance, about which, beneath this control member 73, the main control member 14 is rotatably mounted. This member 14 is actually pressed upwardly in the direction of the control member 73 by a coil spring 77 disposed about the pin 15 and beneath this main control member 14 (see for example figures 24 and 29).

[0088] The control member 73 is coupled to the control member 14 and is capable of controlling its operation in a manner which will be described better hereinafter. For this purpose the upper face of the control member 14, which faces the control member 73, has coupling formations generally indicated 77 in figure 25, intended to cooperate in ways which will be better described hereinafter with corresponding formations formed in the lower face of the control member 73 and generally indicated

78 in figure 26.

[0089] The loose coupling between the upper end of the fixed pin 15 and the shaped aperture 76 of control member 73 is such as to allow this latter to perform a limbed rotation about its pivot axis 74 under the control of the bimetallic strip 72 in dependence on the temperature of the heating resistor 71.

[0090] The coupling formations 77 of the main control member 14 include a central hub 79 in which is defined a central axial aperture 80 into which the fixed pin 15 extends.

[0091] On opposite sides of the lateral surface of the hub 79 it has two essentially parallel flats 81, 82 of which the first is more extensive chordally than the second. The distance between the planes of these flats is indicated d1 in figure 25.

[0092] The proximal portion or root of the hub 79 is surrounded by the eccentric cam 30. The upper surface of this cam 30 has respective lower and upper portions 83 and 84 respectively, offset from one another and connected by two inclined planes 85 (of which only one is visible in figure 25). The inclined planes 85 join at their upper ends with respective teeth 86 which are upstanding with respect to the plane of the upper portion 84 of the upper surface of the cam 30.

[0093] As better seen in figures 26 and 27, the aperture 76 of the control lever 73 has a section essentially corresponding to the connection of two circumferences having different diameters. In particular, an end portion 76a of this aperture has a diameter corresponding essentially to, or slightly greater than, that of the fixed pin 15 (figure 27). The remaining portion 76b of the aperture 76 has a diameter corresponding essentially to, or slightly greater than, the diameter d of the hub 79 of the control member 14.

[0094] In the lower face of the control lever 73 about the centre of the portion 76a there is formed a seat or recess 87 in the aperture 76 (figure 27), the sidewall of which has a diameter corresponding essentially to, or slightly greater than, the diameter d of the hub 79 of the member 14. The cylindrical sidewall of the recess 87 joins with that of the portion 76b of the aperture 76 through two facing parallel flats 88 and 89, of which the first is more extensive than the second. The distance between these flats, indicated d2 in figures 26 and 32, corresponds essentially to, or is slightly greater than, the distance d1 between the flats 81 and 82 of the hub 79 of the control member 14 (see in particular figure 32).

[0095] In normal operation the coupling between the control member 73 and the main control member 14 is such that the hub 79 of the member 14 extends into the recess 87 of the control member 73. In particular, in this condition, the upper surface 79a of the hub 79 is in contact with the bottom wall 87a of the recess 87.

[0096] With reference to figures 26 and 27 the lower face of the control member 73 has an essentially flat surface portion 73a which by means of two ascending inclined surfaces 90 and 91 joins with a flat surface 92

which surrounds the recess 87 and which is in turn arcuate and lowered with respect to a main surface 93 of the lower face of the member 73.

[0097] In normal operation the topmost surface 84 of the cam 30 (figure 25) slides against the above-described surface 92.

[0098] In figures 28 - 32, the door lock device 1 is shown in the door closed but not locked condition. In this condition the tail 32 of the slide member 13 is not blocked by the cam profile of the member 14 (figure 29). The hub 79 of this control member 14 extends into the recess or seat 87 of the control member 73 (figures 31 and 32), the distal end of the fixed pin 15 extends into the smaller diameter portion 76a of the shaped aperture 76. In this condition, as better appreciated by observing figure 32, the control member 73 cannot rotate about the axis 74 relative to the control member 14 because of the angular position assumed by the hub 79 of the member 14 in the seat 87 of the member 73.

[0099] The tip or tooth of the feeler member 61 engages in the notch 68 of the cam 60 (figure 3) so that the movable contact 63 interconnects the fixed contacts 64 and 65, providing an indication that the door is closed but not locked (figures 28, 30 and 31).

[0100] Starting from this condition, the activation of the electrical motor 16 causes a rotation of the main control member 14 in such a way that this member passes from the angular position illustrated in figure 30 to that shown in figure 34. The cam profile 31 engages the rear tail 32 of the slide member 13 preventing retraction of this latter (see also figure 33). In this condition the door of the appliance is locked in the closure position. The feeler member 61 engages the projection 69 of the cam 60 (figure 34) and the movable contact 63 connects the fixed contacts 64 and 66 together providing an indication or signal that the door is closed and locked (figures 34 and 35).

[0101] Due to the rotation of the member 14, the hub 79 of this latter is disposed essentially as shown in figure 36, that is with its flats 81 and 82 aligned with the corresponding flats 88 and 89 of the control lever 73. In this condition the hub 79 of the member 14 will be able to allow a relative rotation of the member 73 with respect to the member 14. This rotation is however prevented by the bimetallic strip 72 which maintains the member 73 in the position shown in figures 35 and 36.

[0102] With reference to figure 3, it can be seen that in the device according to figure 23 et seq the feeler projection or pawl 26 of the lever 18 remains engaged in the channel - like seat 37 of the retainer member 10 when the door is locked. This is arranged for the purpose of allowing that, in the case of a subsequent emergency release operation (upon failure of the electrical supply) the door of the appliance nevertheless remains closed. It is necessary, however, in the course of locking the door that the retainer member 10 performs a slight rotation so as to leave a certain relative clearance for the projection or pawl 26 of the lever 18. This can be easily

achieved by suitably shaping the abutment formation indicated 40 for example in figures 5 and 6.

[0103] In "normal" operation the rotation of the main cam member 14 to allow opening of the door causes raising of the lever 18 and release of the retainer member 10.

[0104] If, whilst the door is closed and locked, the electrical supply fails, the heating resistor 71 gradually cools and correspondingly tends gradually to "straighten out" the bimetallic strip 72.

[0105] Now, starting from the position shown in figure 36, the control member 73 is turned about the axis 74, this rotation being permitted by the alignment between the flats 88 and 89 of this member with the flats 81 and 82 of the hub 79 of the member 14. The member 73 now gradually moves into the position shown in the drawings by 37 - 39. In this condition the hub 79 of the member 14 faces and its axis is in alignment with the greater diameter portion 76b of the aperture 76 in the member 73 (figure 38) and, under the thrust of the spring 77 (figure 39) is displaced along the fixed pin 15 towards the member 73 by an amount such as to allow disengagement of the cam 31 from the tail 32 of the slide member 13 (figures 39 and 40). The slide member 13 can thus displace allowing the passage of the retainer member 10 to the position shown in figure 39, in which the door of the domestic electrical appliance is closed but not locked. Correspondingly, the feeler member 61 engages a portion of the cam profile 60 which is lowered with respect to the projection 69 (see figure 40) so that the movable contact 63 is disposed in an intermediate position between the contacts 66 and 65 (figure 41).

[0106] It is now possible for the door to be reopened by the user by exerting a pressure or a traction on it. If the electrical energy supply is reinstated after an emergency release (obviously whilst the door is closed) the electric motor 16 of the door lock device can be reactivated (by the electronic control unit of the appliance) with a sufficient delay to allow the PTC 71 resistor to heat the bimetallic strip 72 preliminarily. The activation of the electric motor 16 causes a rotation of the member 14 during which the inclined planes 86 of the member 14 meet the corresponding inclined planes 91 and 90 of the control member 73 (figure 26). The coupling between these inclined planes is such as to cause a progressive lowering of the member 14 along the fixed pin 15 until the upper surface 79a of the hub 79 is brought below the level of the bottom surface 77a of the seat 87 of the member 73. The steps 86 (figure 25) serve at this point to ensure that the end surface 79a of the hub 79 of the member 14 is brought slightly below the surface 87a of the seat 87.

[0107] Upon reaching this condition the bimetallic strip 72 causes a rotation of the control member 73 with respect to the member 14 so as to bring these member 14 and 73 into the condition shown in figure 36. Correspondingly, the feeler member 61 re-engages the projection 69 of the cam 60 and the movable contact 63 is



disposed again in the position in which it interconnects the contacts 64 and 66 (figure 35) reinstating the door closed and locked indication.

[0108] Naturally, the principle of the invention remaining the same, the embodiments and details of construction can be widely varied with respect to what has been described and illustrated purely by way of non-limitative example, without by this departing from the ambit of the invention as defined in the annexed claims.

#### Claims

1. A door lock device, particularly for domestic electrical appliances comprising:

- a support structure (2) in which is defined an aperture (3) for the introduction in a predetermined direction of a door catch (4) connected to a door;

- a retainer member (10) movably mounted in the said structure (2) and having a seat or cavity (10) able to receive and retain the said door catch (4);

- a conditioning mechanism (11-13, 18, 25, 33) mounted in the said structure (2) and cooperating with the retainer member (10) and operable to assume

- \* a first condition in which it is able to allow engagement of the door catch (4) with the retainer member (10) to retain the door in a closure position, and release of this coupling to allow opening of the door by the effect of a force on it; and

- \* a second condition in which the retainer member (10) is maintained in a locked position, in which it is able to retain the door in a locked closure position; and

- a motorised control device (14 - 17) associated with the conditioning mechanism and electrically operable to cause the passage of the said conditioning mechanism from the first to the second condition and vice versa.

2. A device according to claim 1, in which the conditioning mechanism (11 - 13, 18, 25, 33) is arranged to allow, in the said first condition, the release of the coupling of the door catch (4) with the retainer member (10) whereby to allow the opening of the door by the effect of a force on the door moving it towards the said support structure.

3. A door lock device according to claim 1 or claim 2,

in which the conditioning mechanism (11-13, 18, 25, 33) is arranged to allow, in the said first condition, release of the coupling of the door catch (4) and the retainer member (10) whereby to allow opening of the door, by the effect of a force on the door away from the said support structure.

4. A device according to preceding claim, in which the motorised control device comprises a rotatable cam member (14) to which is coupled an electrical drive motor (16) capable of interacting with a movable member (13) of the conditioning mechanism (11-13, 18, 25, 33).

5. A device according to any preceding claim, in which the retainer member (10) is mounted in such a way that it is rotatable about an axis (9) orthogonal to the direction of introduction of the door catch (4) into the support structure (2), and is translatable in a guided manner along a direction essentially parallel to the said direction of introduction and in which the conditioning mechanism comprises:

a slide member (13), translatable along a direction orthogonal to the said axis, towards and away from the aperture (3) for introduction of the door catch 4,

an interconnection member (11), the opposite ends of which are articulated to the retainer member (10) and the slide member (13) respectively,

a stop lever (18) a first end of which is supported in a pivotal manner in the support structure (2) and the other or second end of which is able to cooperate with the retainer member (10); and

a resilient release member (25) interposed between an intermediate position of the stop lever (18) and the articulation between the slide member (13) and the interconnection member (11);

the arrangement being such that when the conditioning mechanism is in the said first condition the said second end of the stop lever (18) is able to retain the retainer member (10) in a position in which it is able to hold the door in the said closure position, and to allow disengagement of the retainer member (10) from the said second end of the stop lever (18).

6. A device according to claim 4 and claim 5, in which the said movable member of the conditioning mechanism (11 to 13, 18, 25, 33), which operatively interacts, with the cam member (14) of the control device (14-17) is the said slide member (13).

7. A device according to claim 5 or claim 6, in which the said second end of the stop lever (18) has a feeler projection (26) able to cooperate with a plurality of peripheral formations (35-38) of the retainer member (10). 5
8. A device according to claim 5 or claim 6 in which the retainer member (10) has a lateral feeler projection (126) able to cooperate with a plurality of formations (135 - 138) arranged in a lateral surface of the stop lever (18) in facing relation to the retainer member (10). 10
9. A device according to any of claims from 5 to 8, in which the retainer member (10) has a stop formation (38) able to come up against a stop element (40) of the support structure (2) when the said retainer member (10) is in the locked position. 15
10. A device according to any preceding claim, in which the said support structure (2) has signalling means (38, 39) operable to provide electrical signals indicative of the door closed condition and the door closed and locked condition. 20
11. A device according to claims 5 and 9, in which the said stop lever (18) is pivotably mounted in a plane parallel to the axis of rotation (9) of the retainer member (10) and is capable of interacting with the said retainer member (10) in such a way that it can cause a commutation of a (first) microswitch (38) when the retainer member (10) is in the position in which the door catch (4) is retained in the said door closure position. 25
12. A device according to claim 5 and 9 or 10, in which the said slide member (13) is able to cause a commutation of a second microswitch (39) when the retainer member (10) is in the position in which it retains the door catch (4) in the said door closed and locked position. 30
13. A device according to claim 4, further including a release member (45) movably mounted through the said support structure (2) and capable, by effect of a tension exerted on it of causing a rotation of the said cam member (14) in such a way as to allow return of the conditioning mechanism (11-13, 18, 25, 33) from the said second condition to the said first condition. 35
14. A device according to claim 13, in which the said release member (45) can be drawn under tension against the biasing action generated by at least one resilient integral projection (49) thereof reacting against an associated abutment formation (50) of the support structure (2). 40
15. A device according to claim 13 or claim 14, in which the motorised control device comprises a gear transmission (17) coupled to the said cam member (14), and in which the said release member (45) includes a rack portion (45c) able to engage with a toothed pinion (46) of the said gear transmission (17). 45
16. A device according to claim 15, in which the said rack portion (45c) is formed in a resilient terminal branch of an end portion (45b) of the release member (45), of U-shape configuration. 50
17. A device according to claim 16, in which the said support structure (2) is provided with guide means (48) operable to guide the displacement of the said rack portion (45c) of the release member (45) along predetermined paths when this latter is actuated and when this latter is released. 55
18. A device according to claims from 3 to 6, in which the said slide member (13) is associated with a flexible abutment member (41) operable, when the retainer member (10) is in the position in which it retains the door catch (4) in the door closure position, to stop the slide member (13) at a predetermined distance from the cam member (14); the said abutment element (41) being capable of flexing to allow a displacement of the slide member (13) towards the cam member (14) whereby to allow disengagement of the striker member (4) from the retainer member (10) by the effect of a force exerted on the door towards its open position.
19. A device according to claims from 4 to 6 and 9, in which the said cam member (40) comprises a first cam profile (31) capable of interacting with the said slide member (13) and a second cam profile (30) capable of interacting with the said stop lever (18) and to cause pivoting thereof in a plane at least approximately orthogonal to the axis of rotation (9) of the retainer member (10) to disengage the said stop lever (18) from the retainer member (10) when this latter reaches the said locked position.
20. A device according to any preceding claim, in which the motorised control device includes the unidirectional or bidirectional DC or AC electric motor (16).
21. A device according to any of claims from 1 to 11 and from 13 to 19, in which the motorised control device includes a rotatable cam member (14) having a reference position profile (60) to which is associated a feeler member (61) in turn associated with a movable contact member (63) able to cooperate with at least one pair of fixed contacts (65, 66); the arrangement being such that the movable contact (63) is able to move into contact with a first and a second

fixed contact (65, 66) respectively when the retainer member (10) is in the condition in which it retains the door catch (4) in the said closure position and in the said locked closure position of the door respectively.

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22. A device according to claim 1, further including detector means (71) operable to detect the presence of electrical energy at the supplied terminals (70; 65; 66) of the device, the said detector means (71) being coupled to the said motorised control device (11-13, 18, 25, 33) in such a way that if the electrical energy to the said electrical terminals fails whilst the said retainer member (10) is in the locked position, the motorised control device (14-17) is influenced in such a way as to allow the conditioning mechanism (11-13, 18, 25, 33) to pass to the said first condition.
23. A device according to claims 21 and 22, in which the said cam member (14) is axially translatablely mounted, under the action of associated resilient means (77), between an active position in which it is capable of interacting with the said conditioning mechanism (11-13, 18, 25, 33) and an inactive position in which it is capable of allowing the said mechanism to return to the said first condition, and including an enablement device (72, 73) which is associated with the said cam member (14) and in turn controlled by the said detector means (71) in such a way as to allow passage of the cam member (14) to the inactive position if electrical energy to the said terminals fails whilst the retainer member (10) is in the locked position.
24. A device according to claim 22 or 23, in which the said detector means include a heating resistor (71) and the movable control enablement device (73) associated with the cam member (14) is controlled by the bimetallic strip (72) thermally coupled to the said resistor (71).

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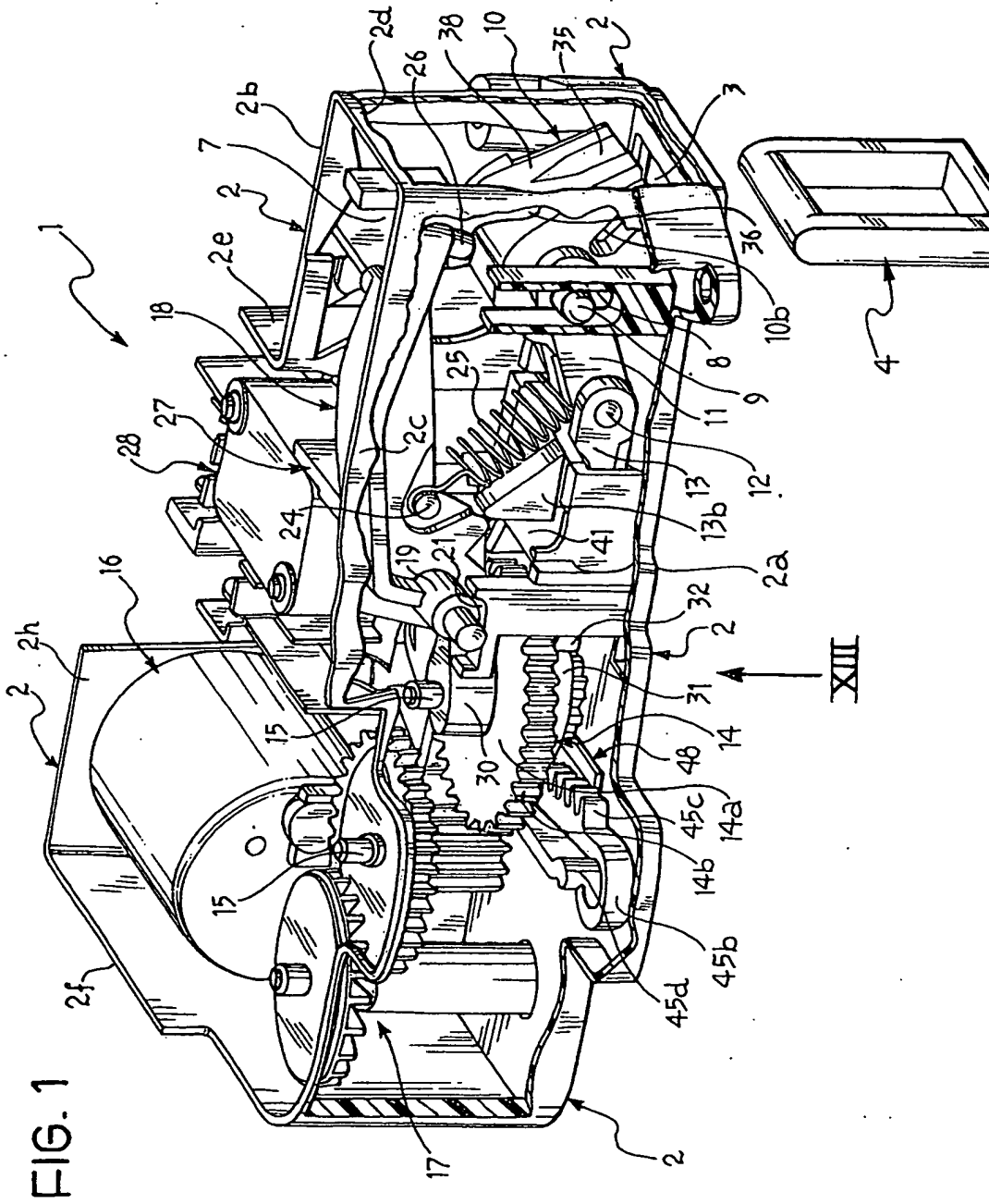
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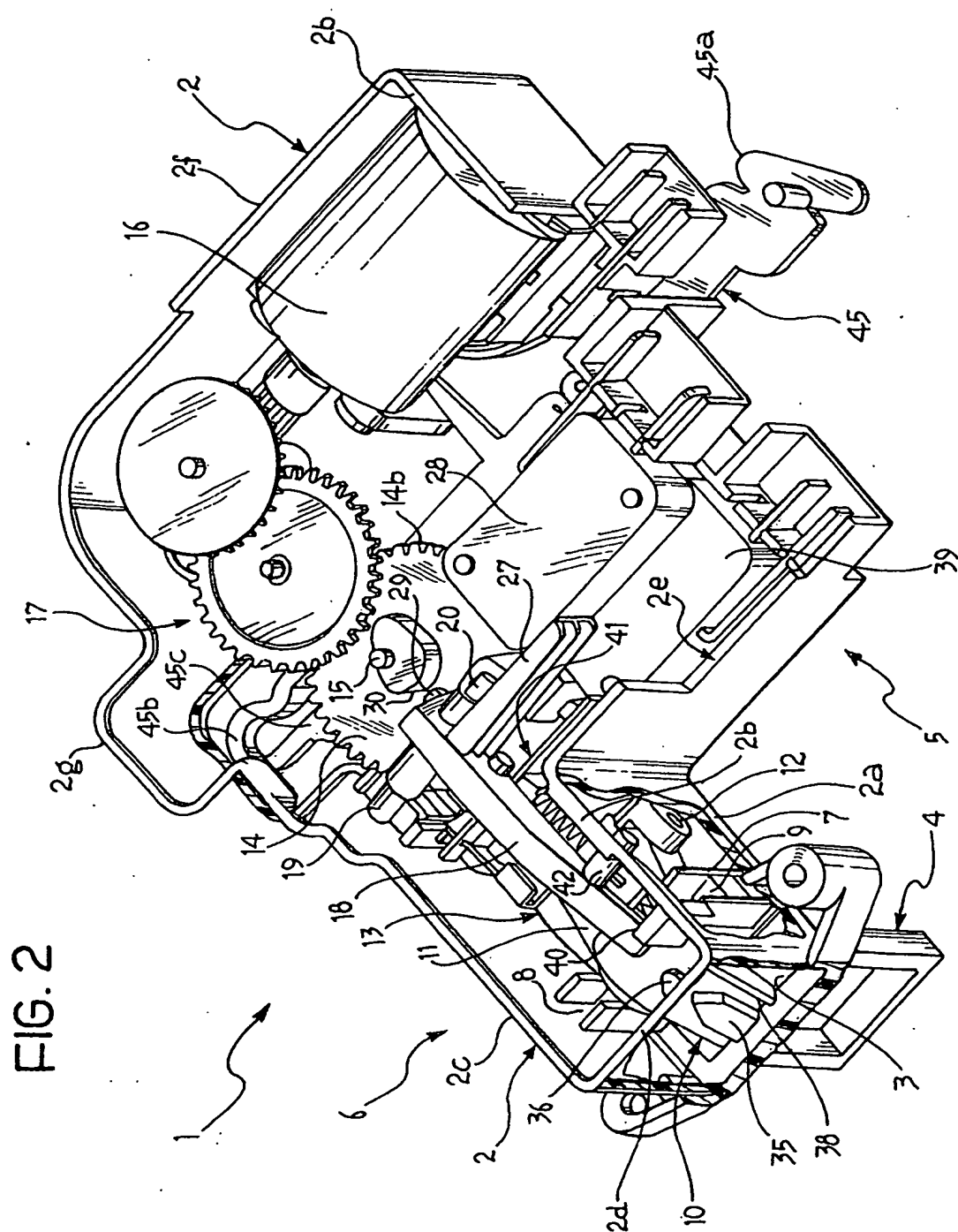
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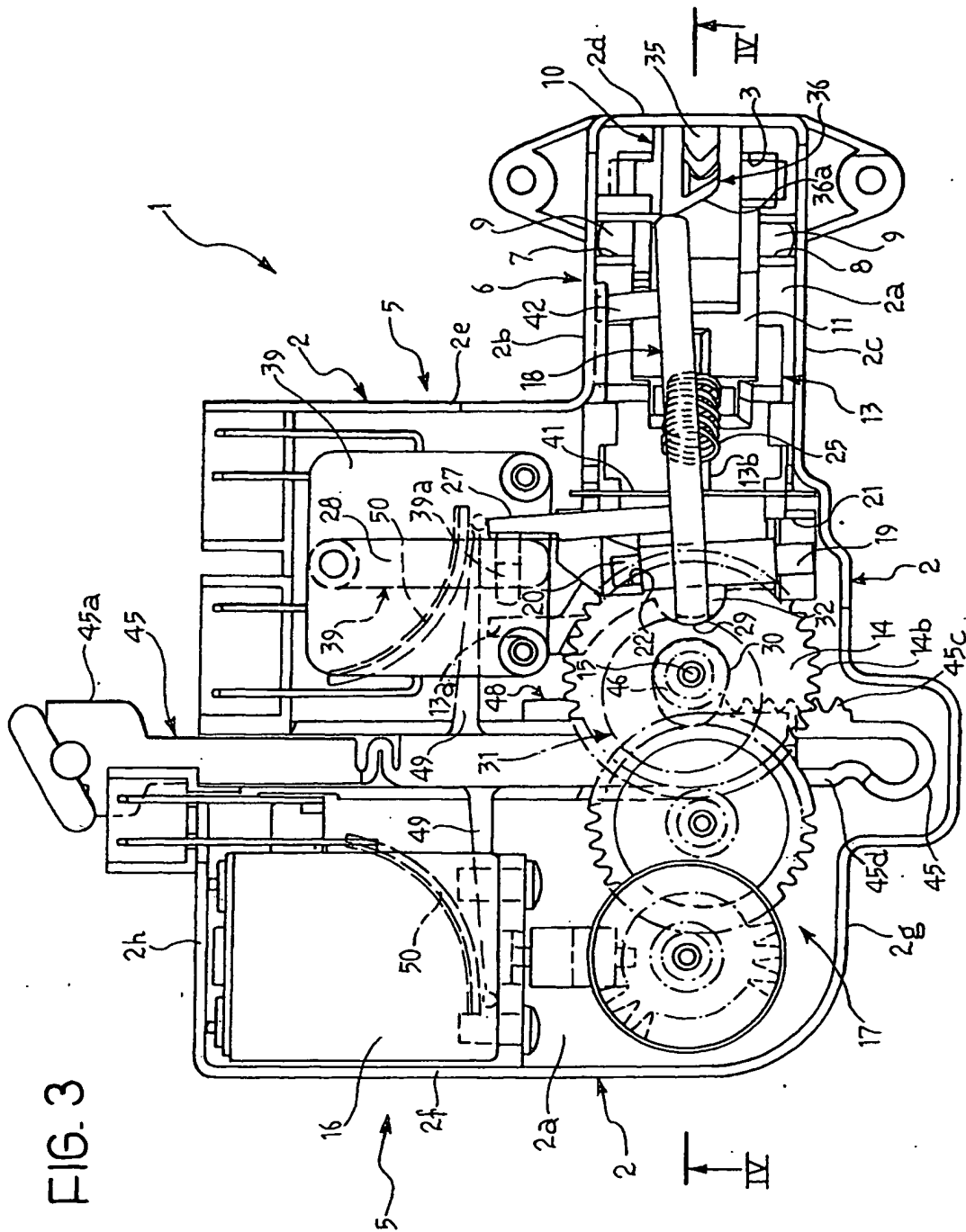
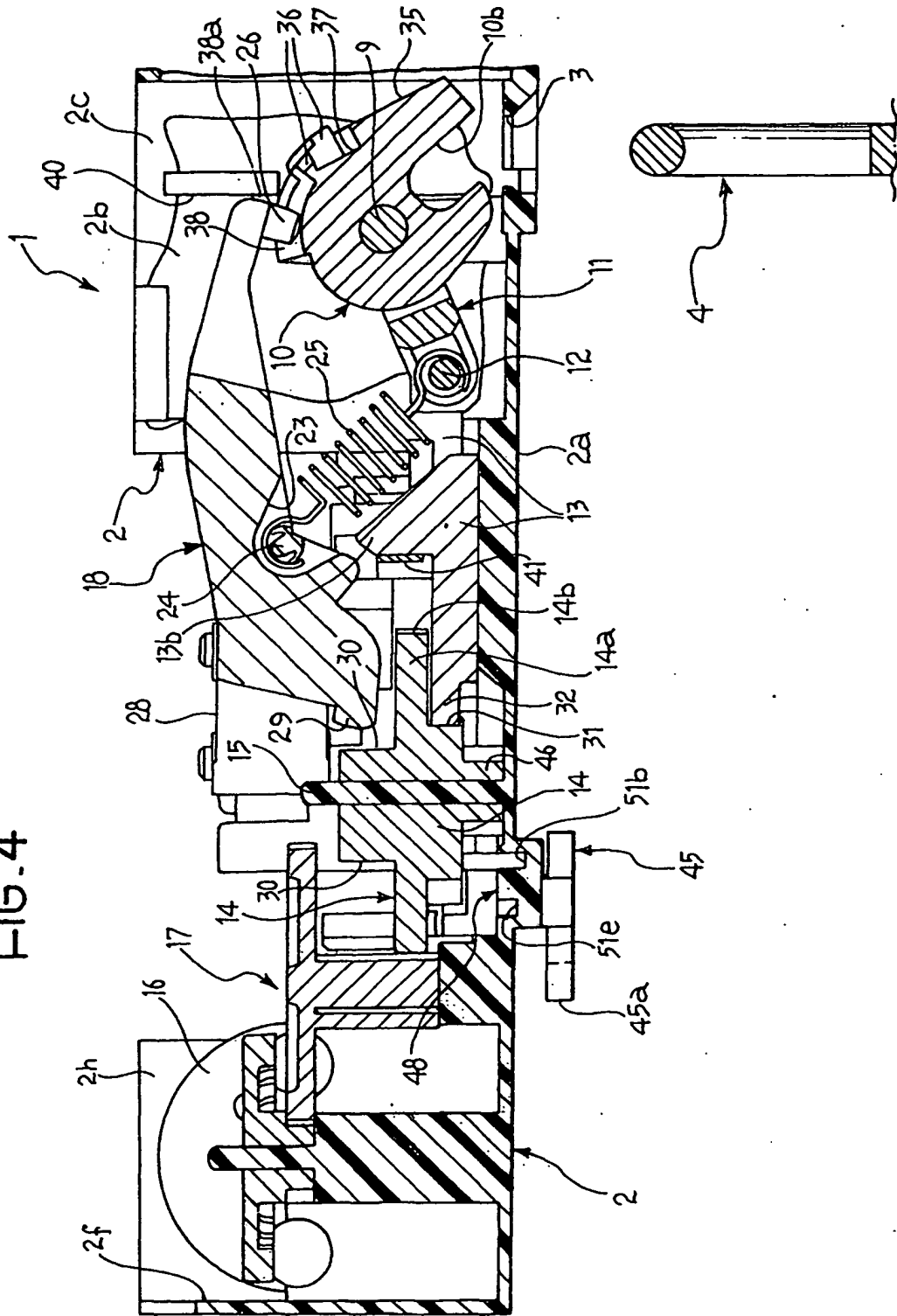


FIG. 4



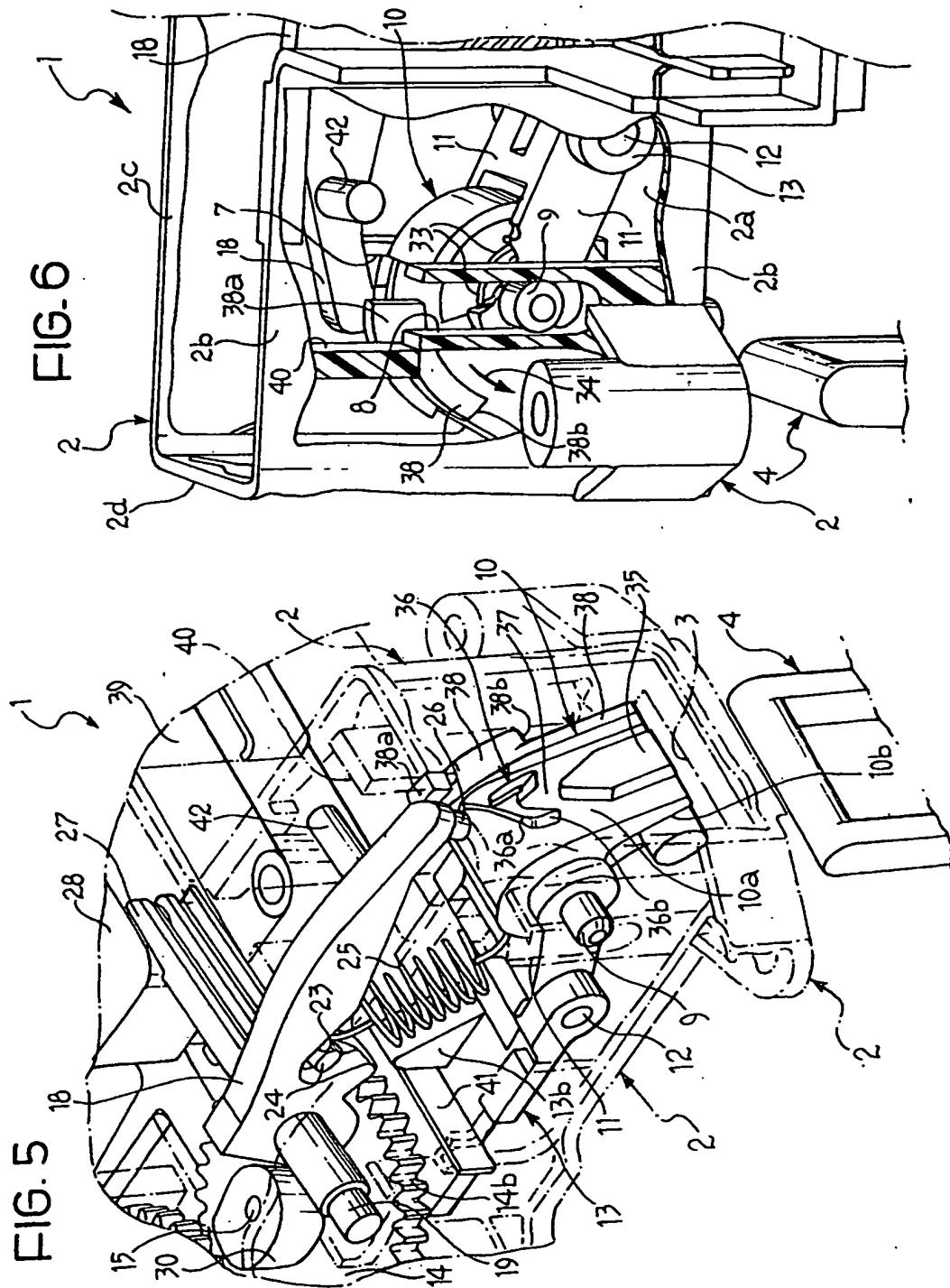




FIG. 7

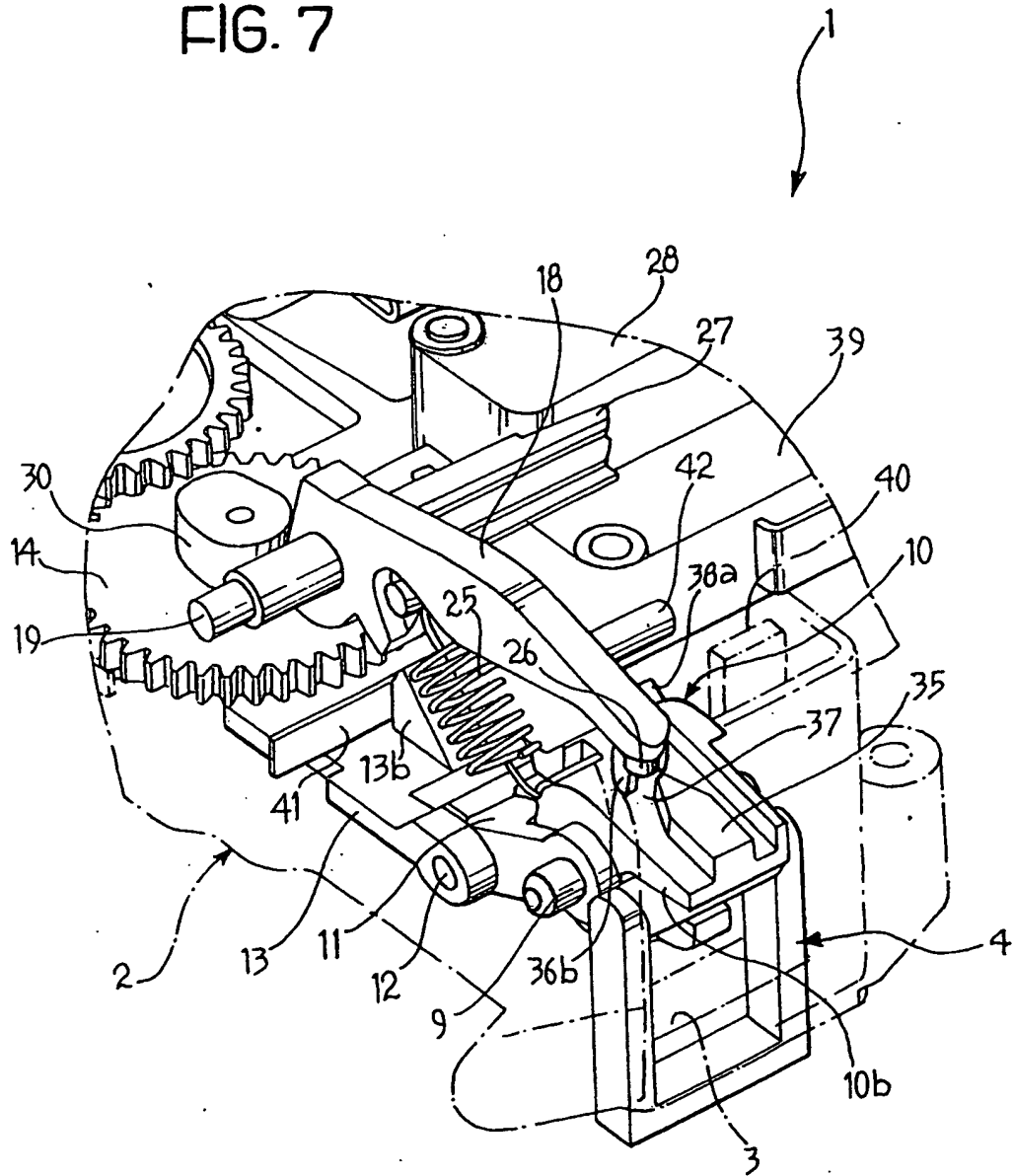


FIG. 8

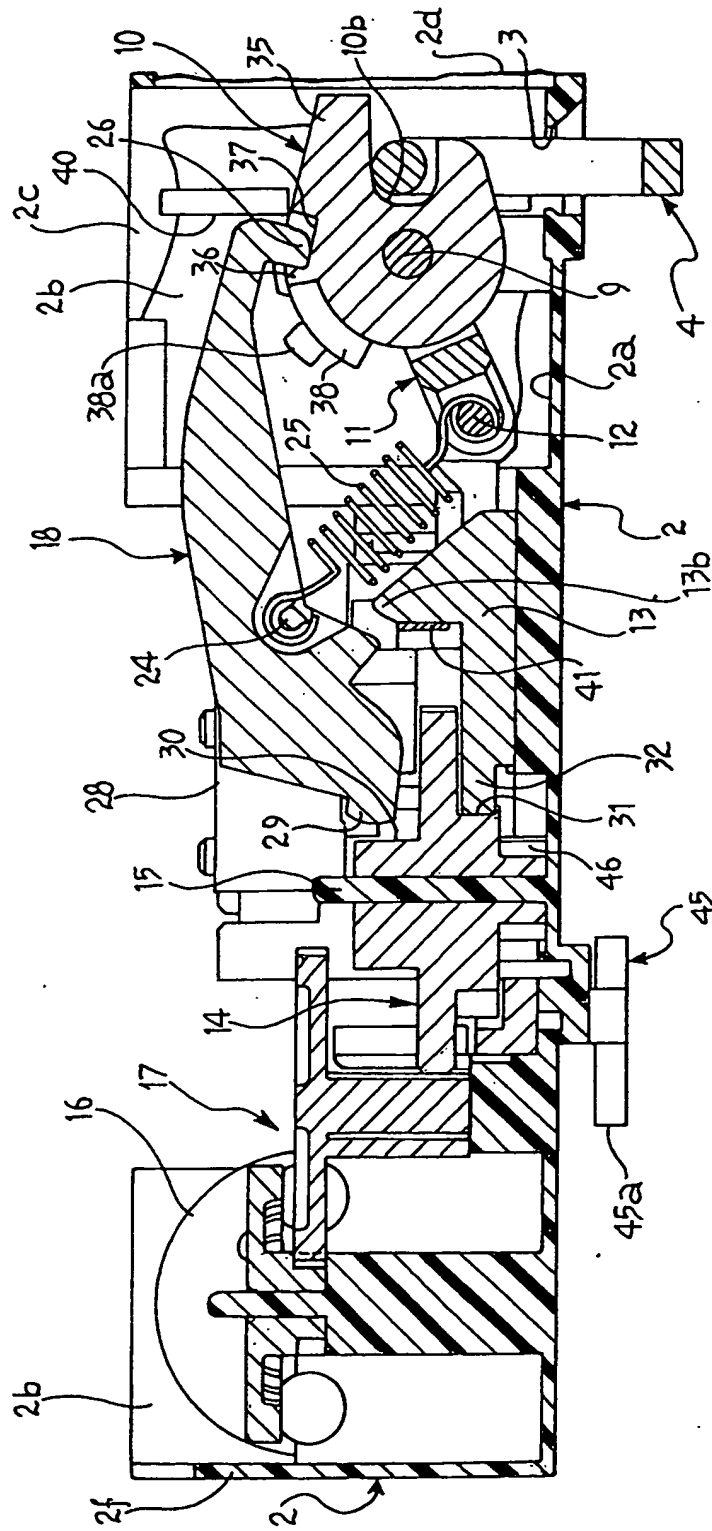


FIG. 9

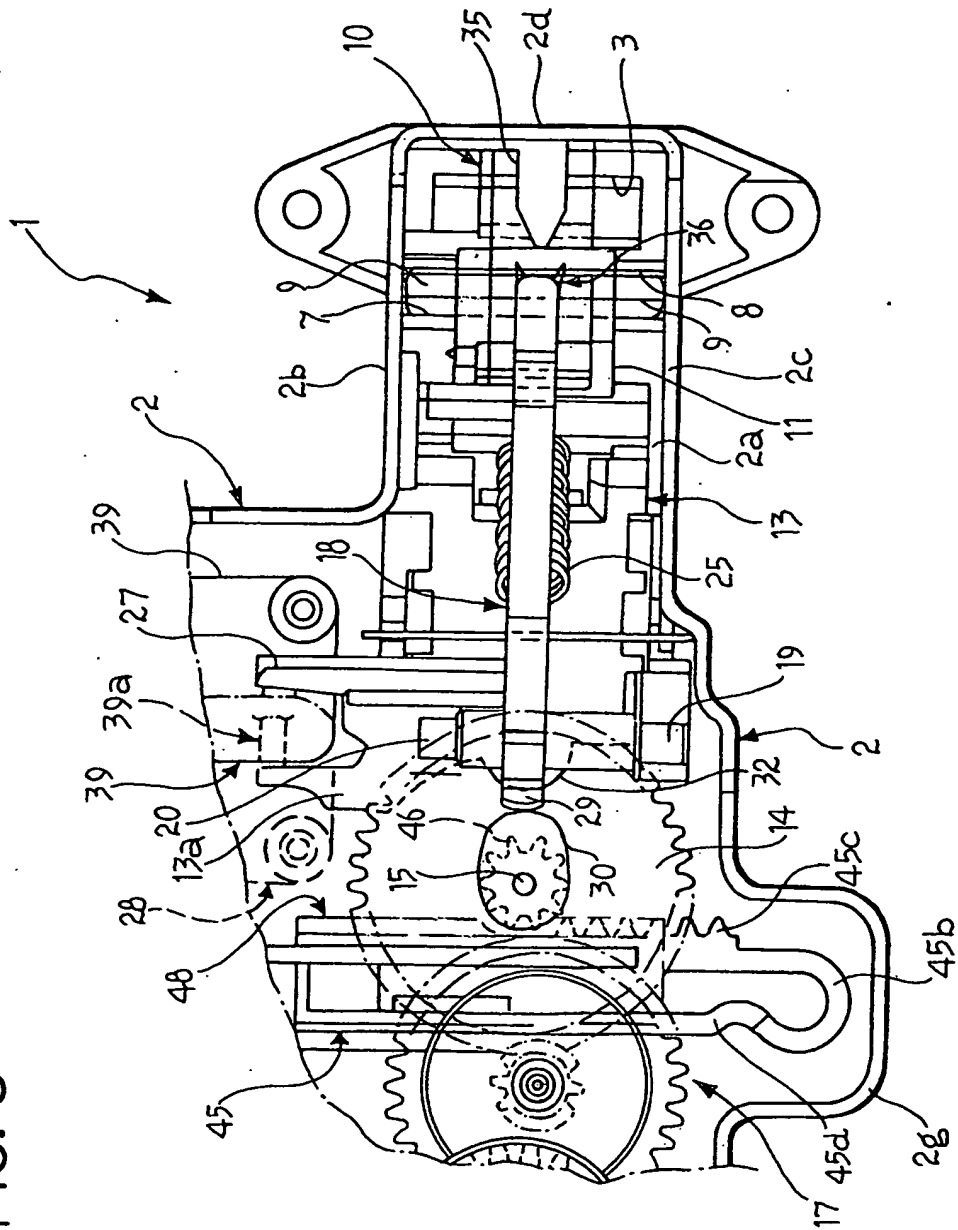
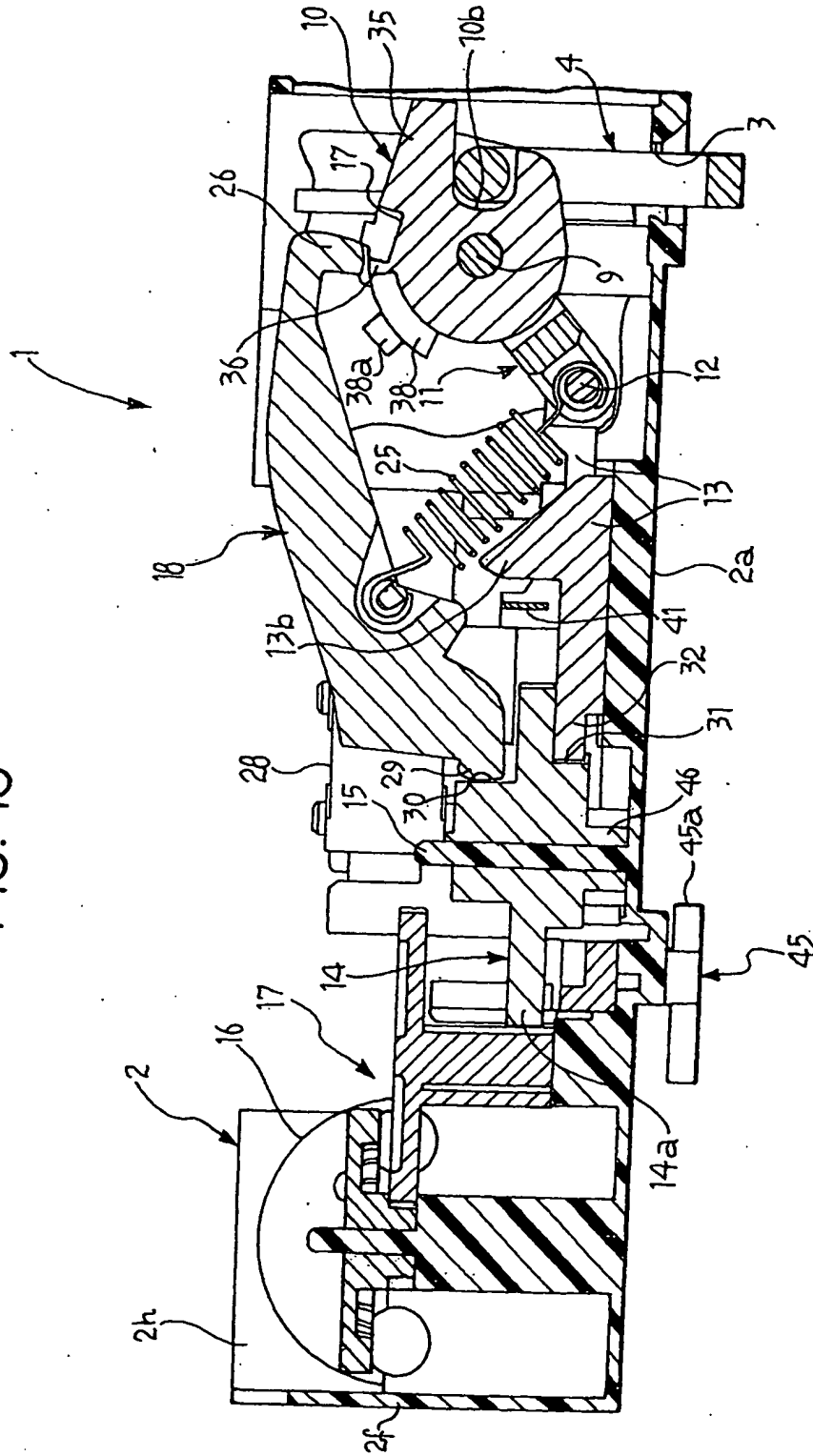


FIG. 10



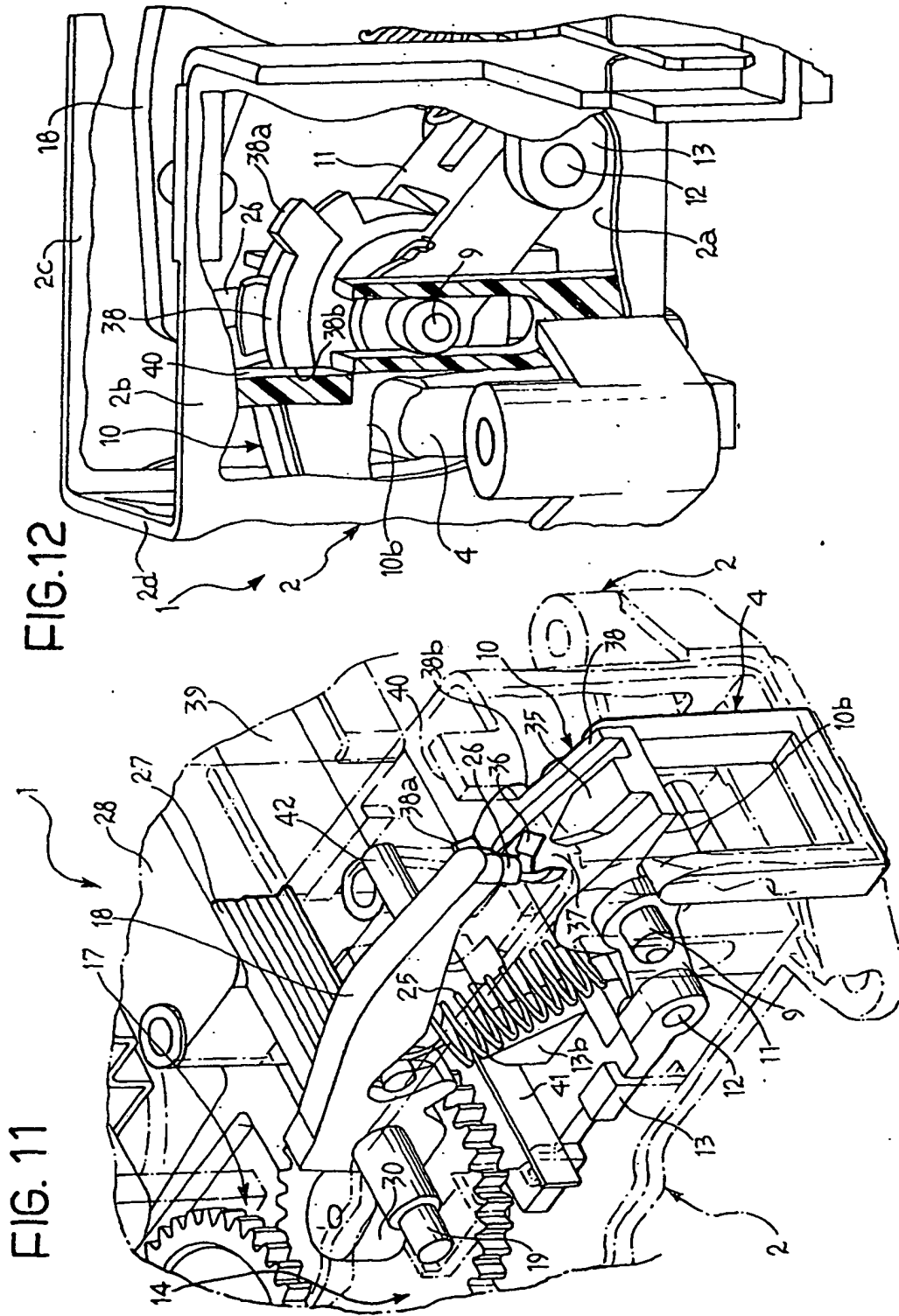


FIG. 13

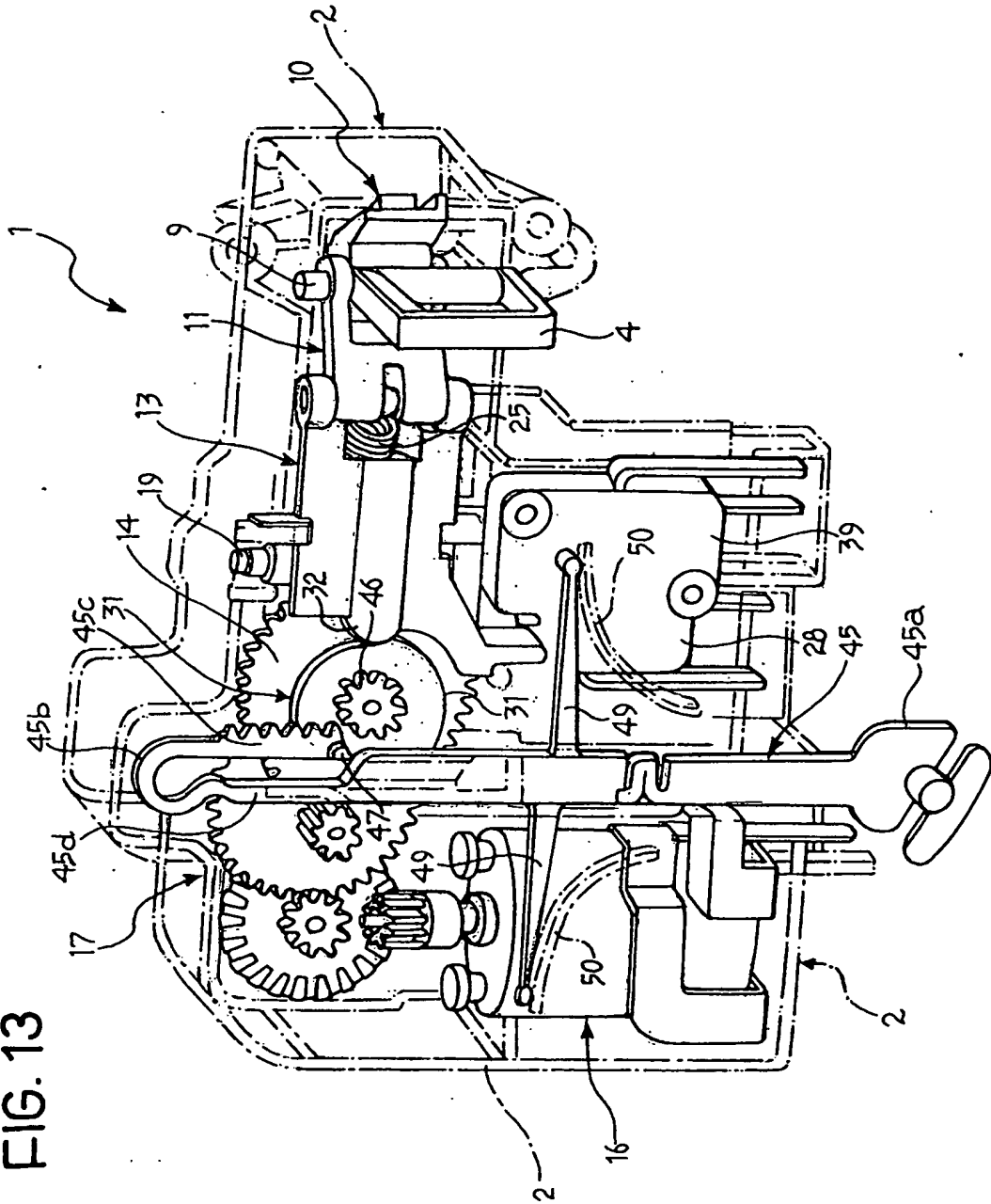
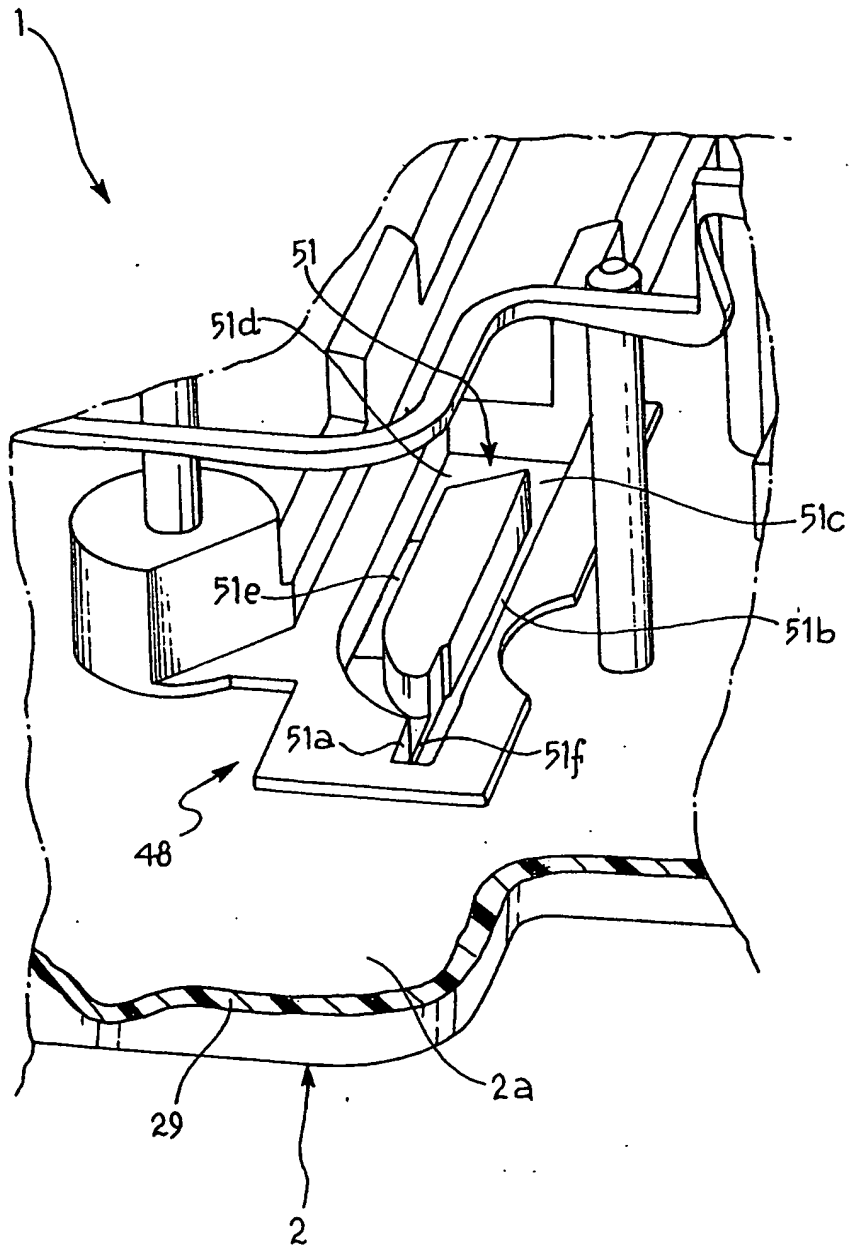


FIG. 14



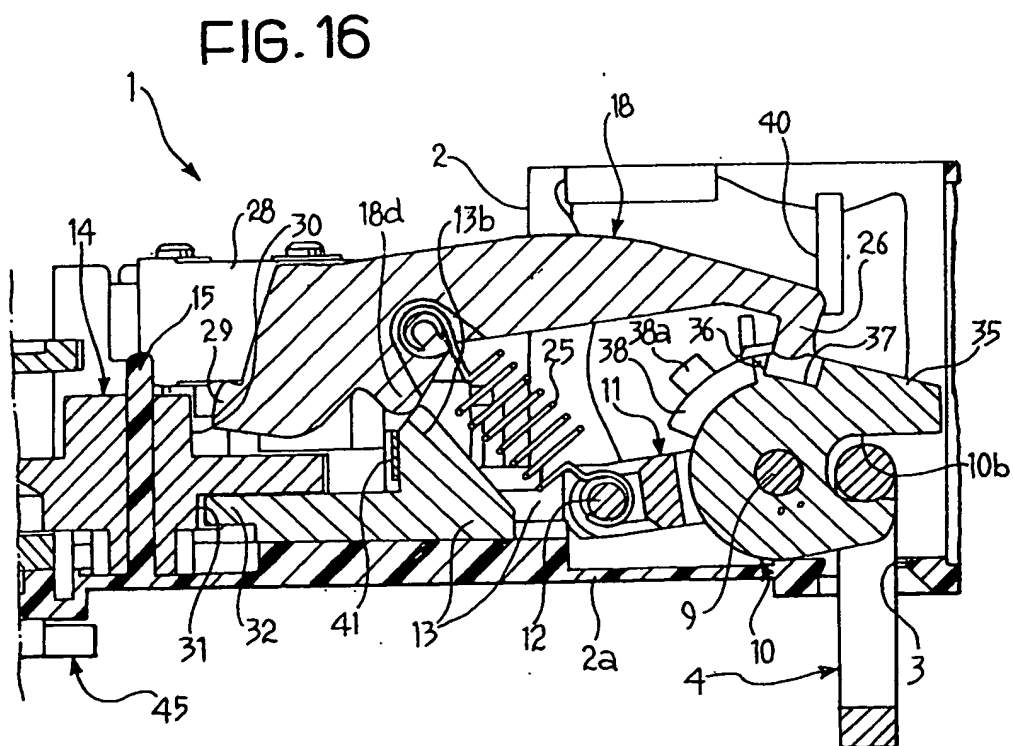
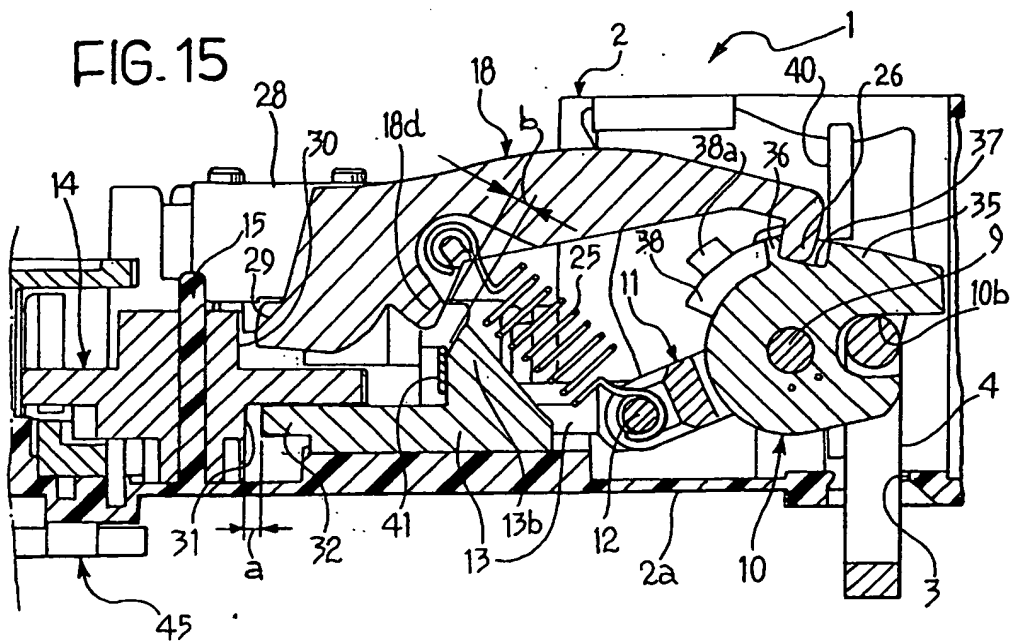




FIG. 17

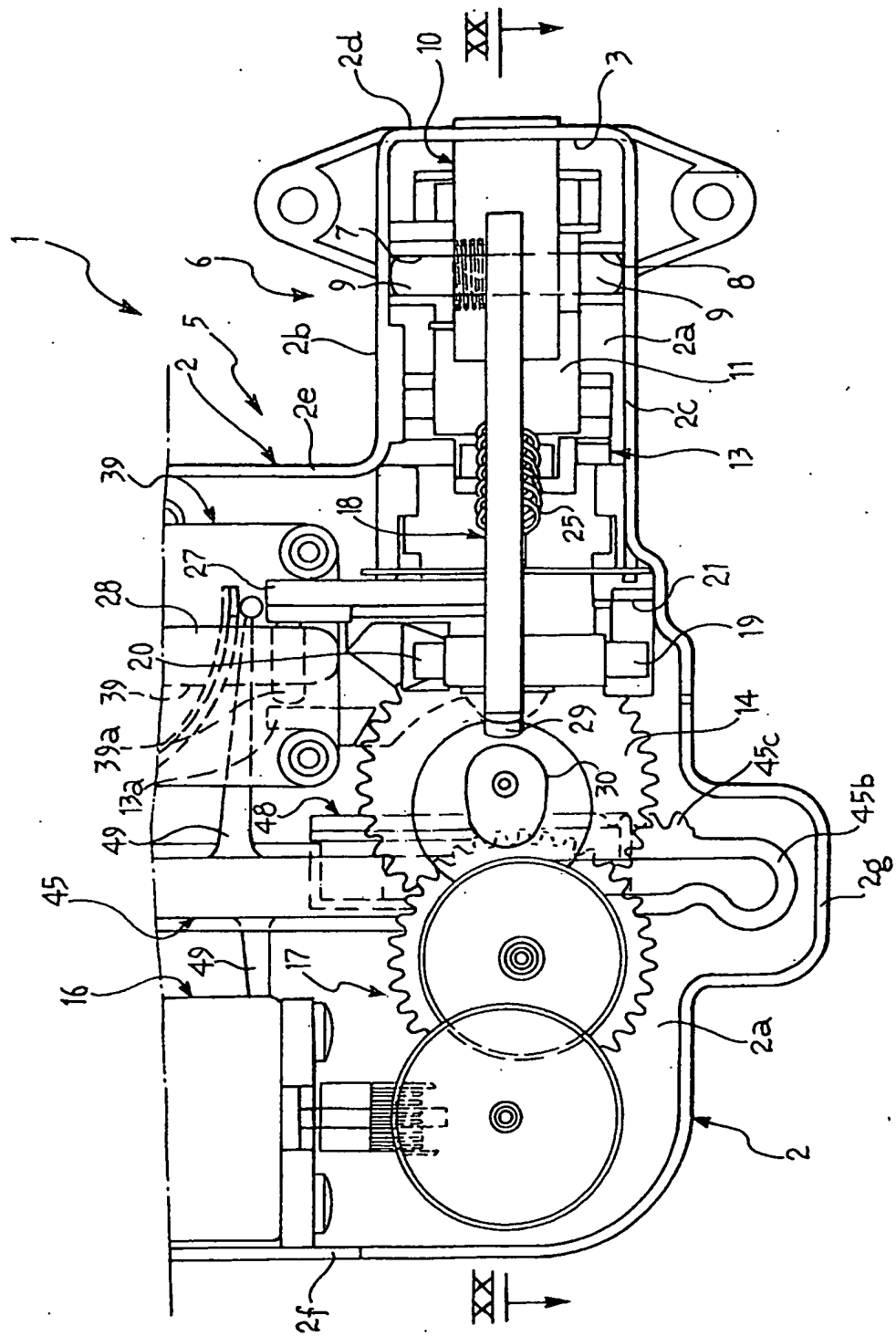


FIG. 18

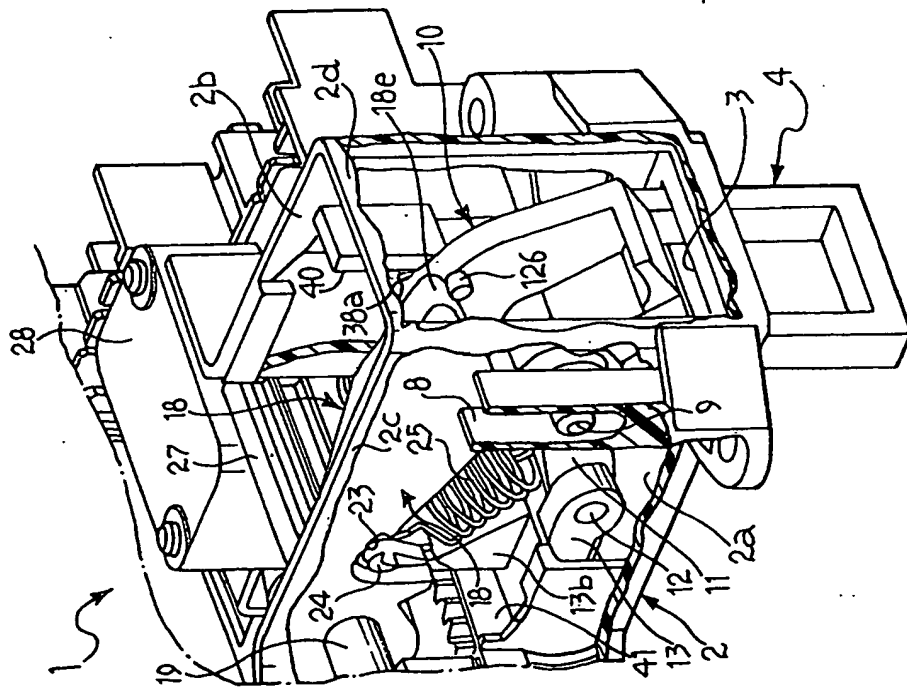


FIG. 19

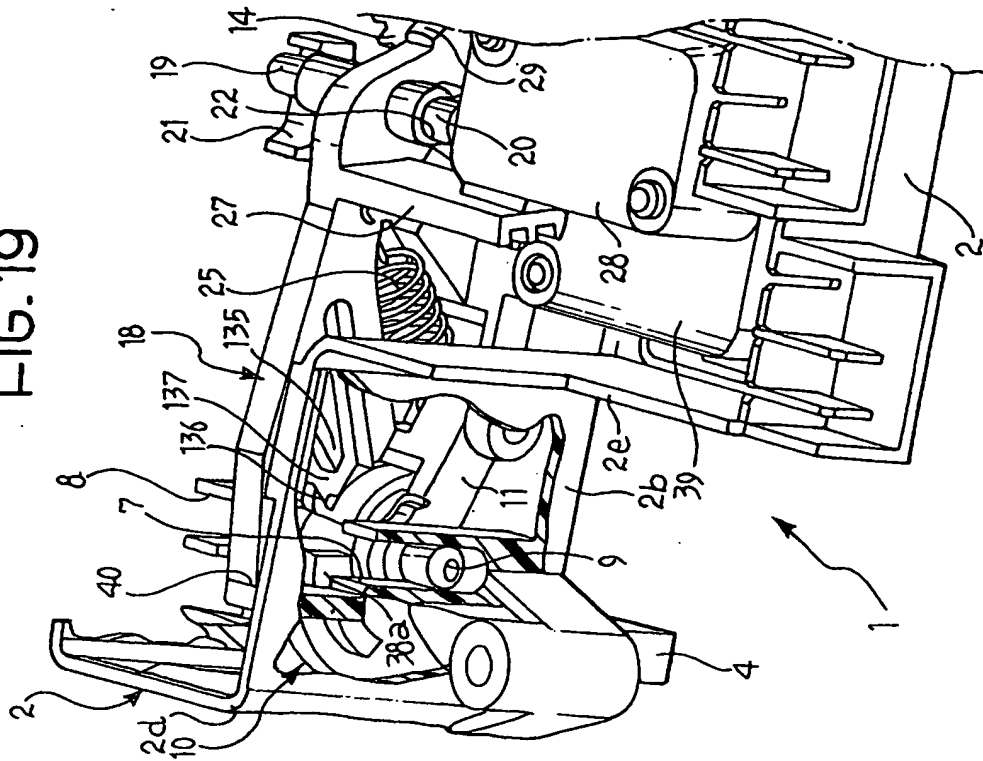
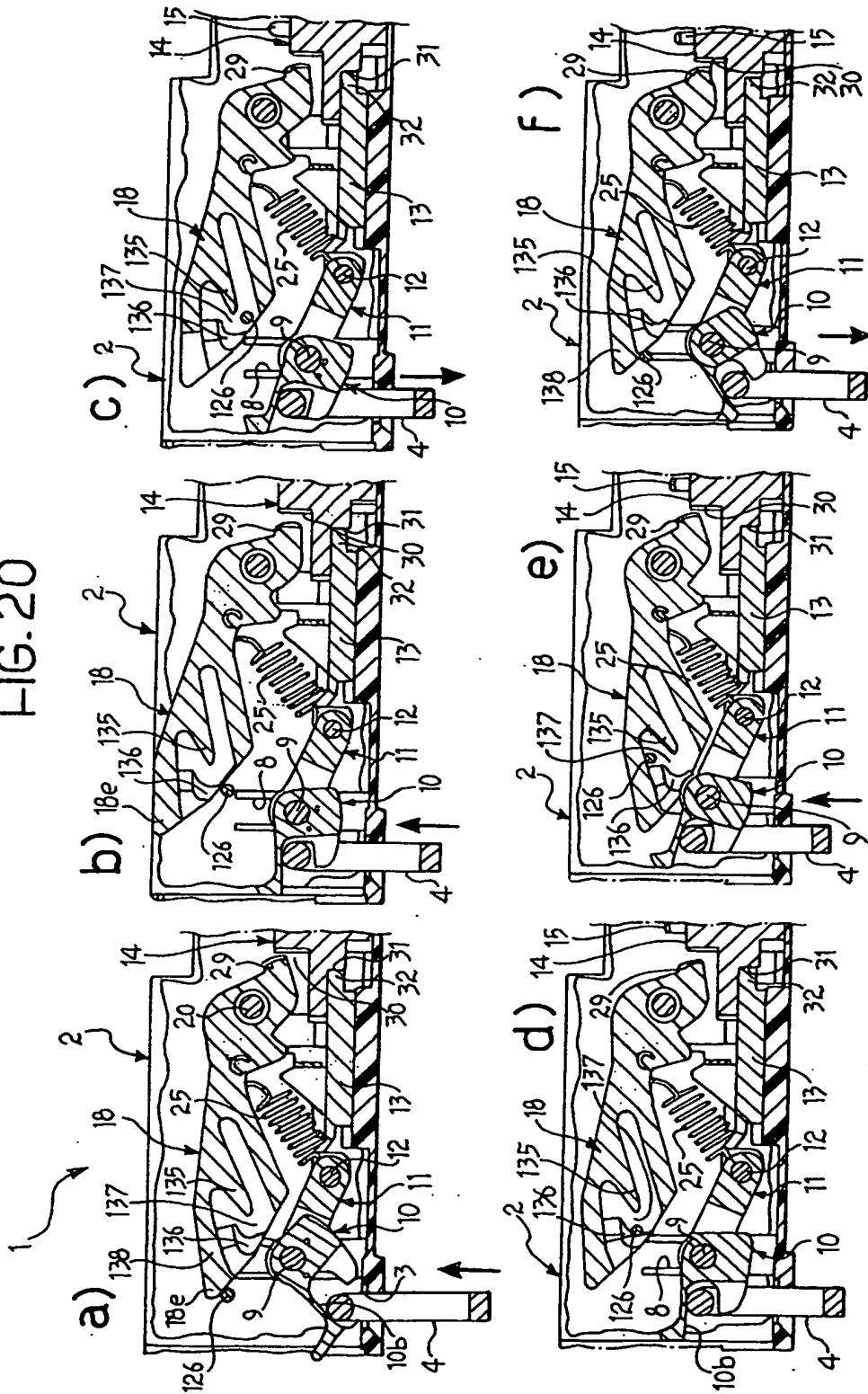


FIG. 20



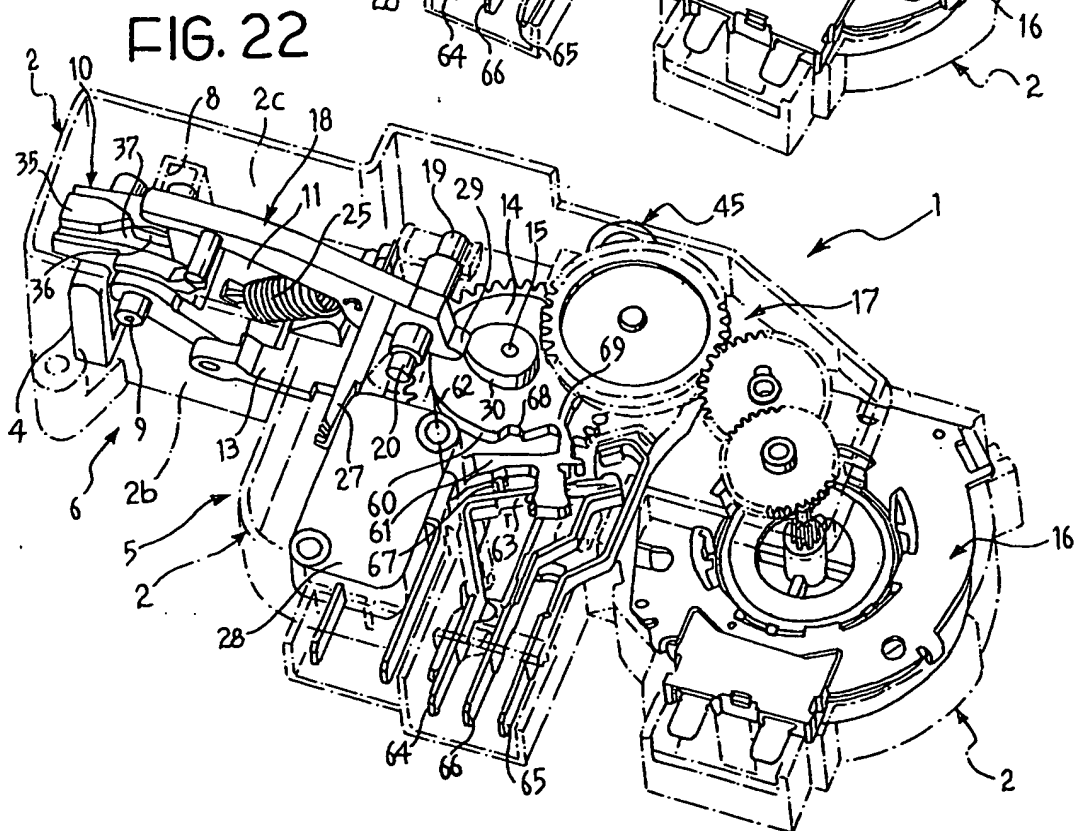
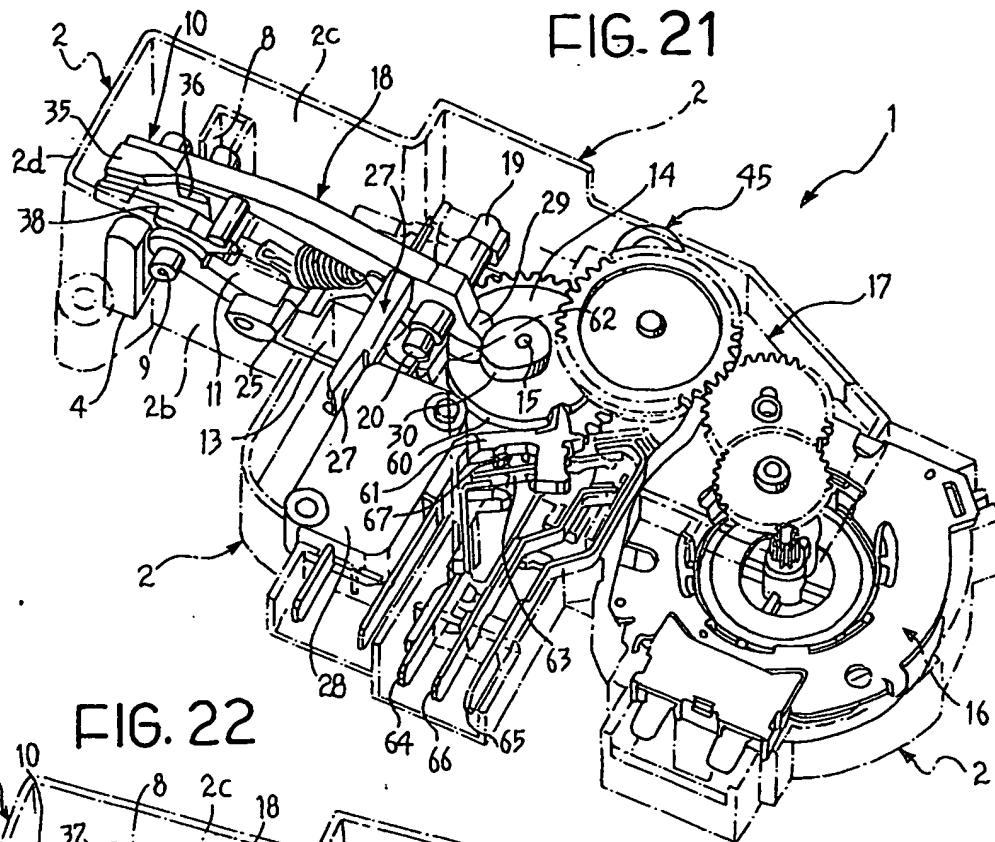
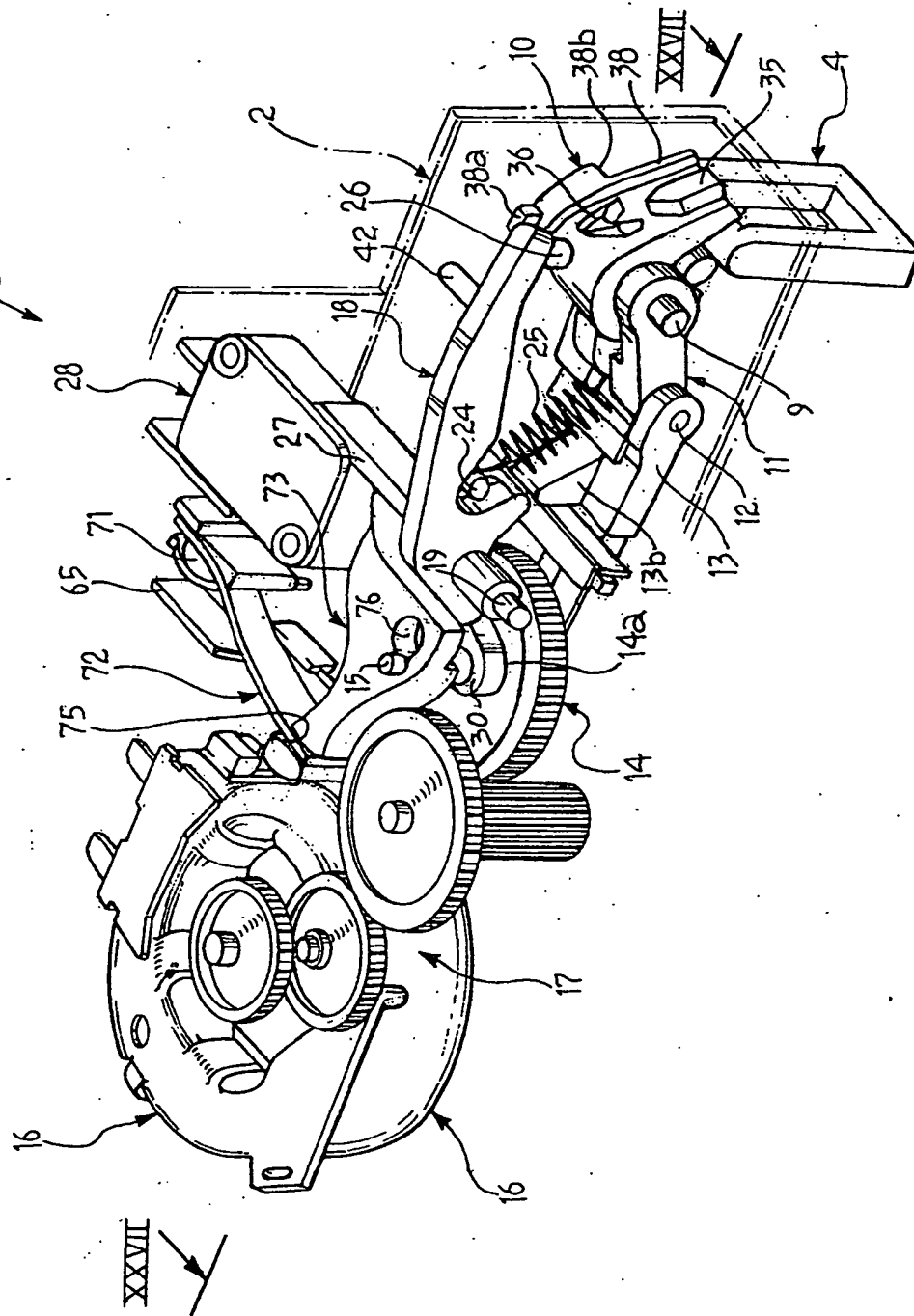


FIG. 23



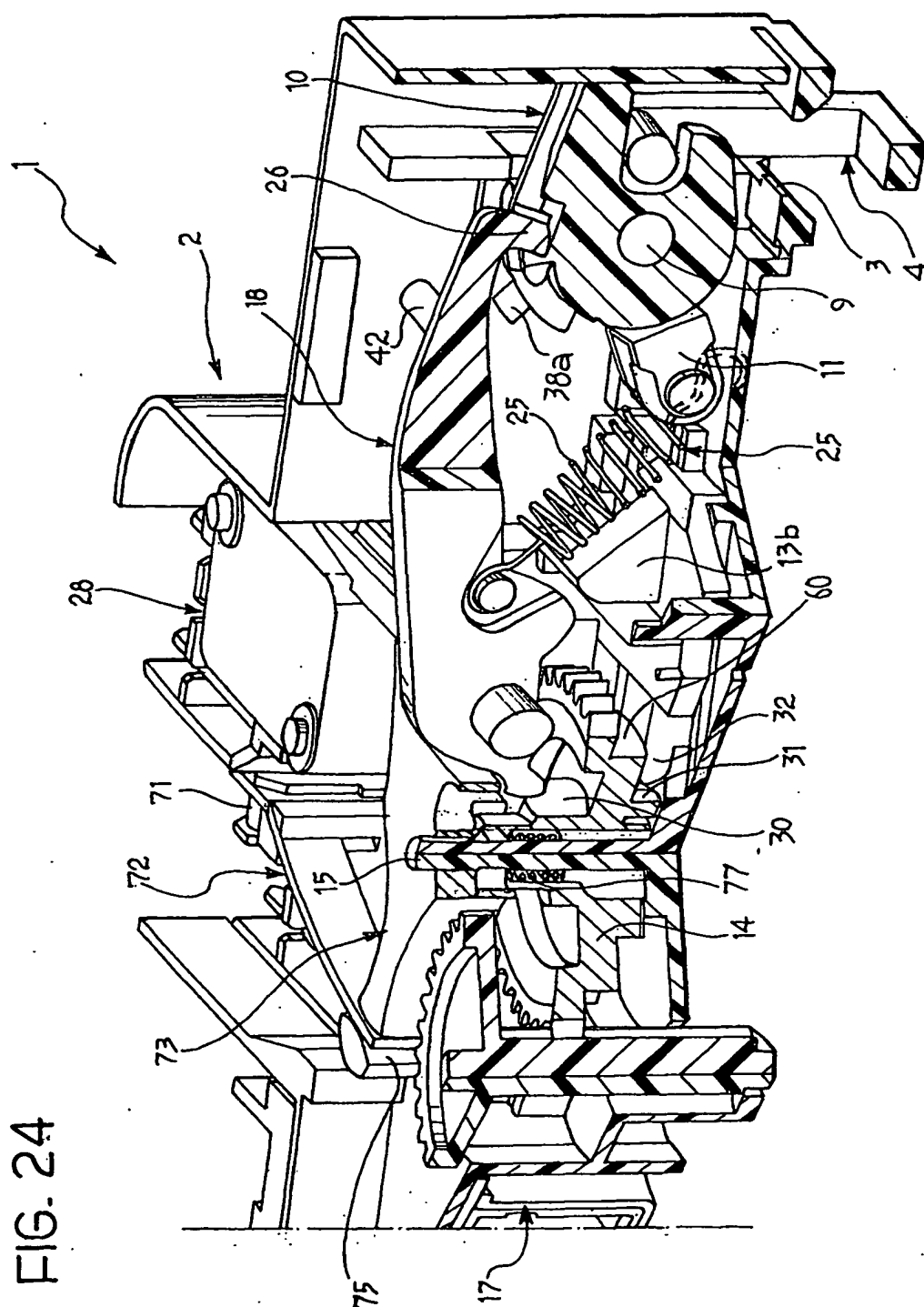


FIG. 25

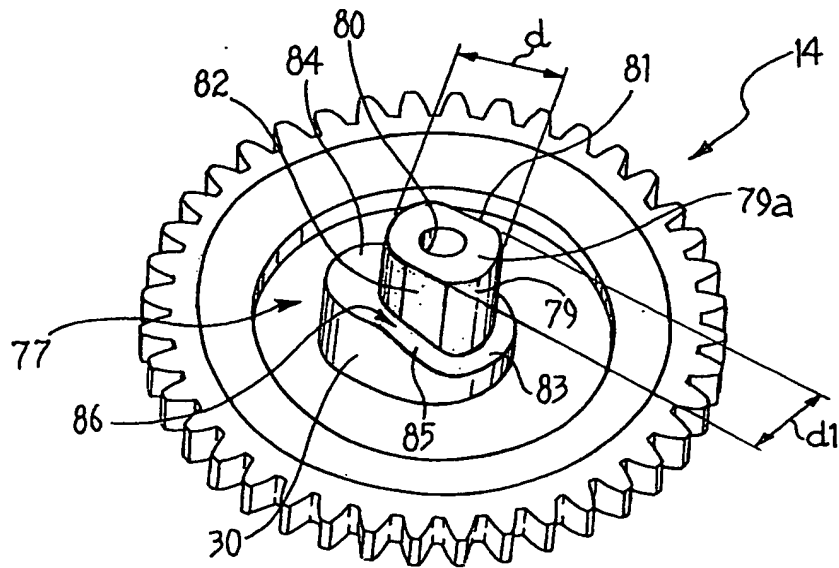


FIG. 26

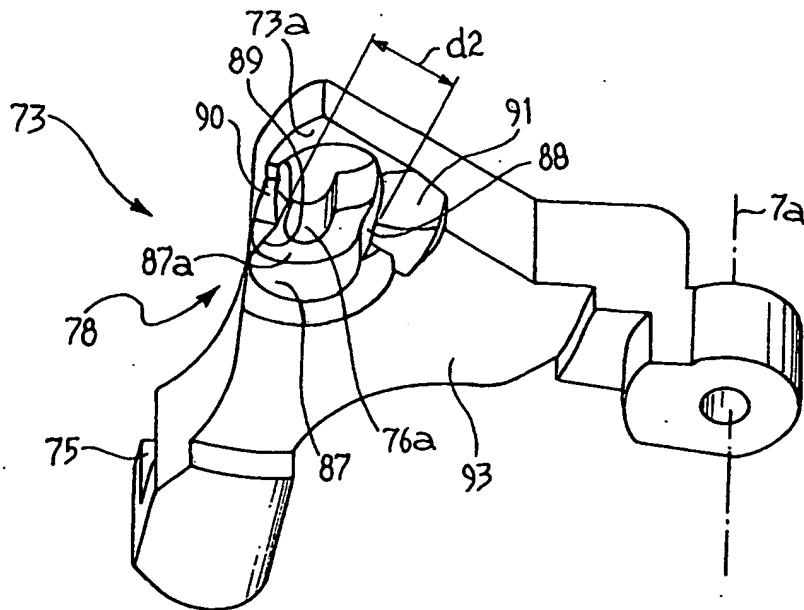


FIG. 27

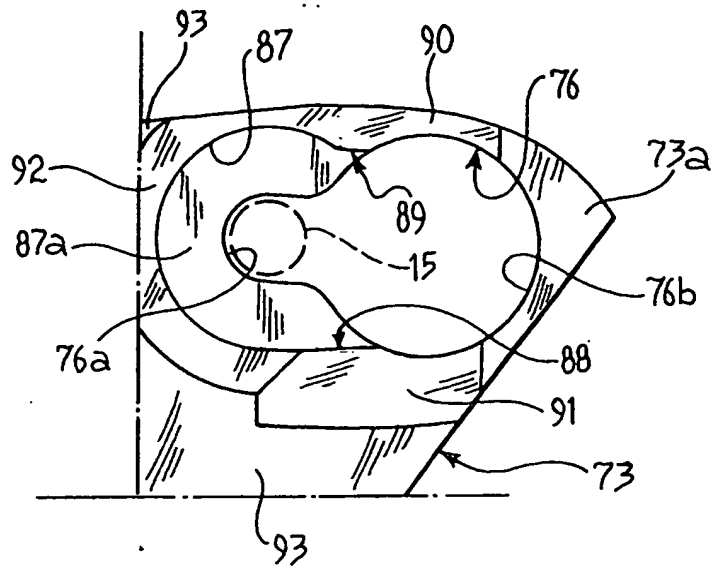


FIG. 32

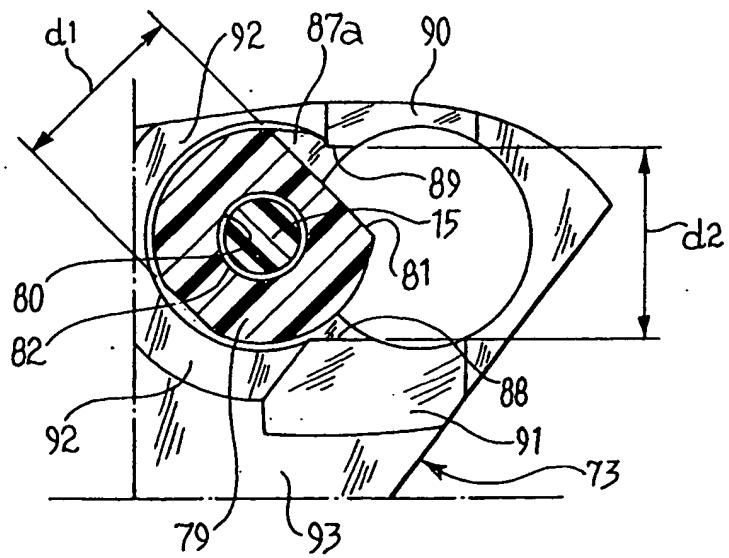




FIG. 28

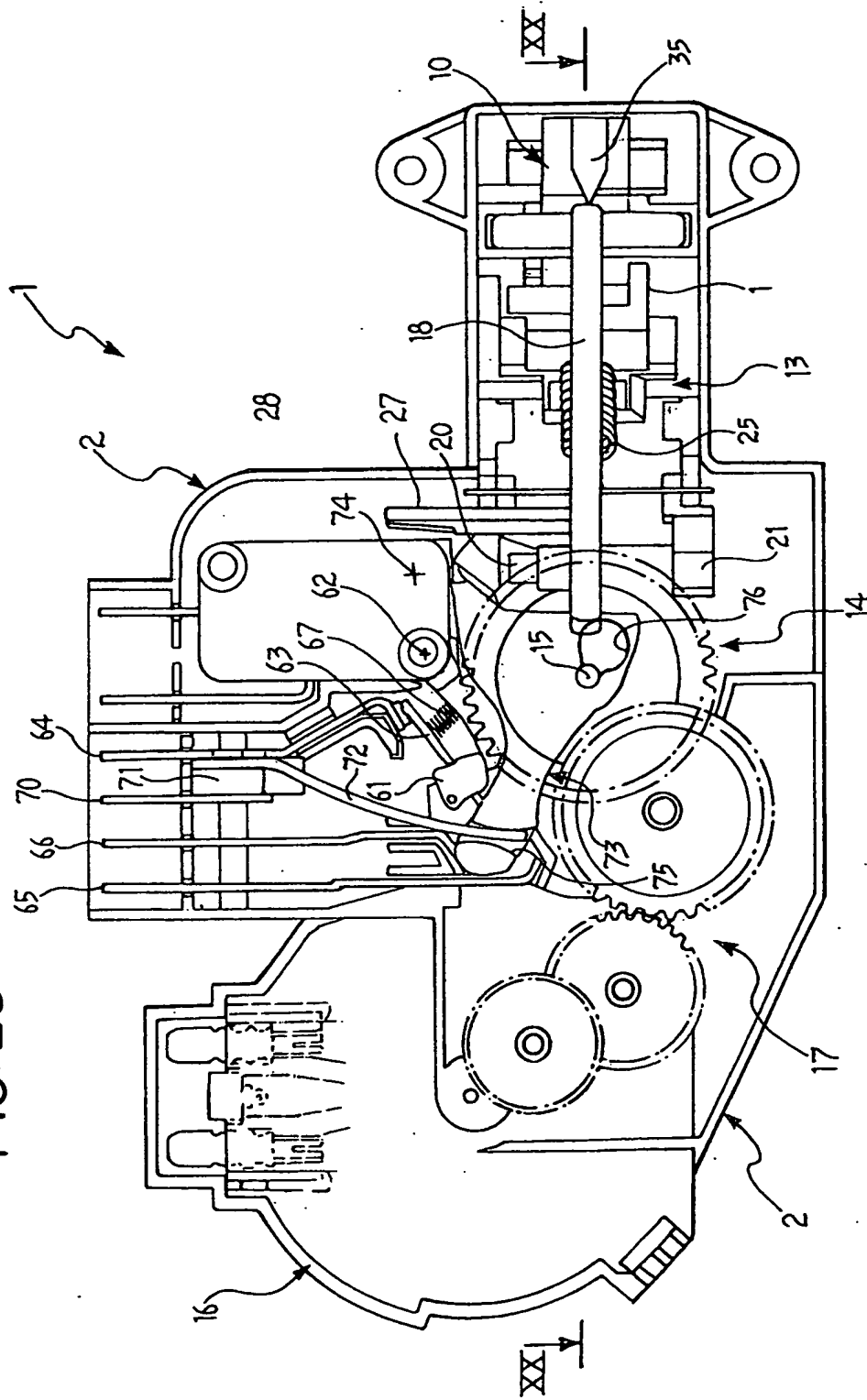


FIG. 29

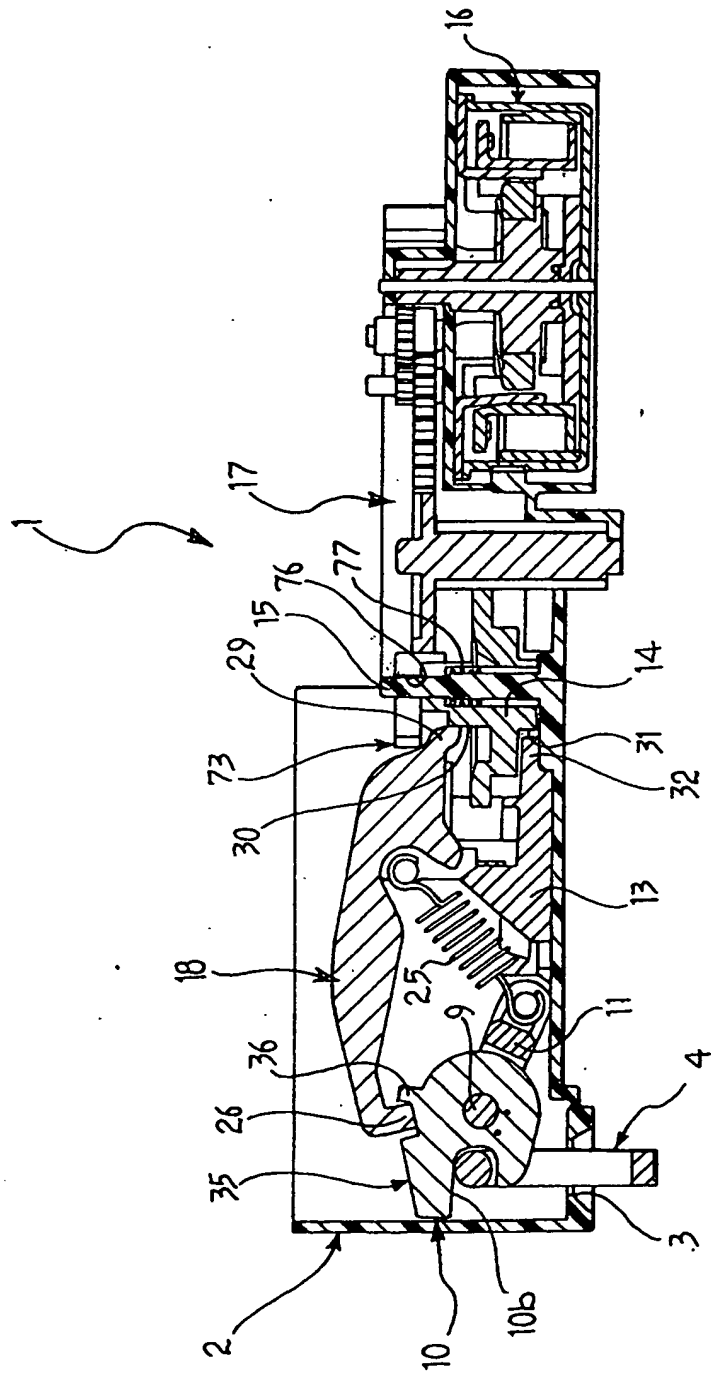


FIG. 30

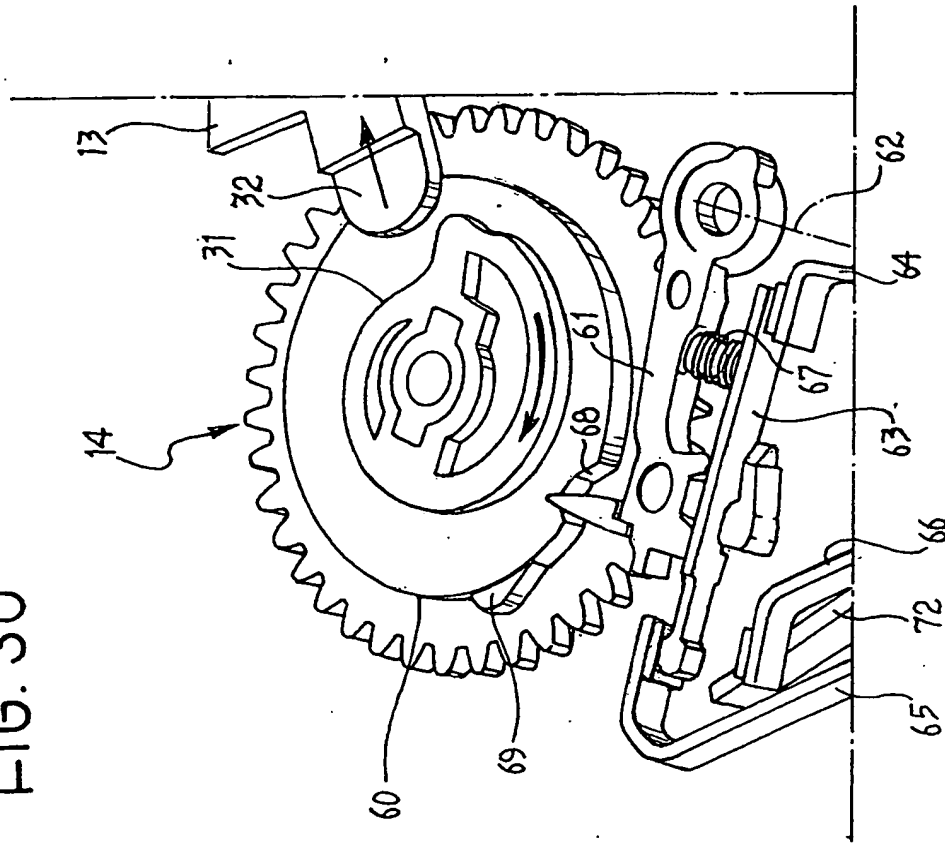


FIG. 31

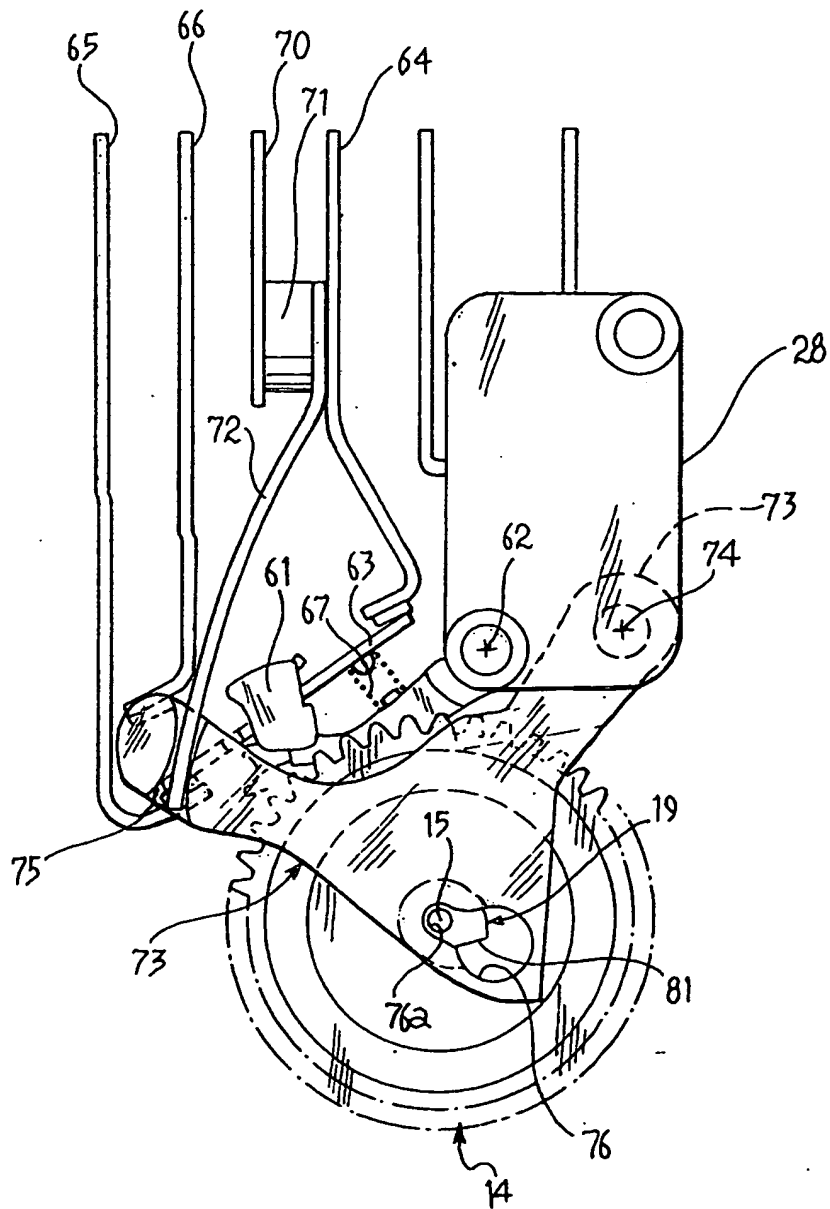


FIG. 33

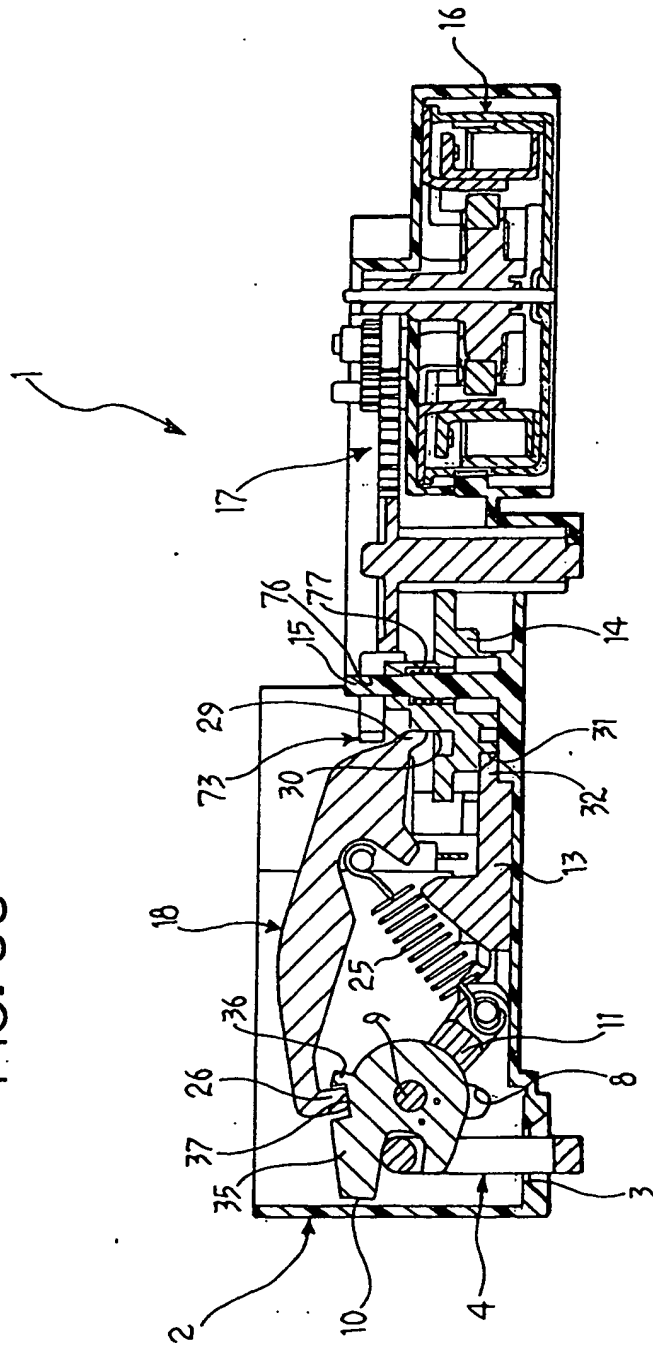


FIG. 34

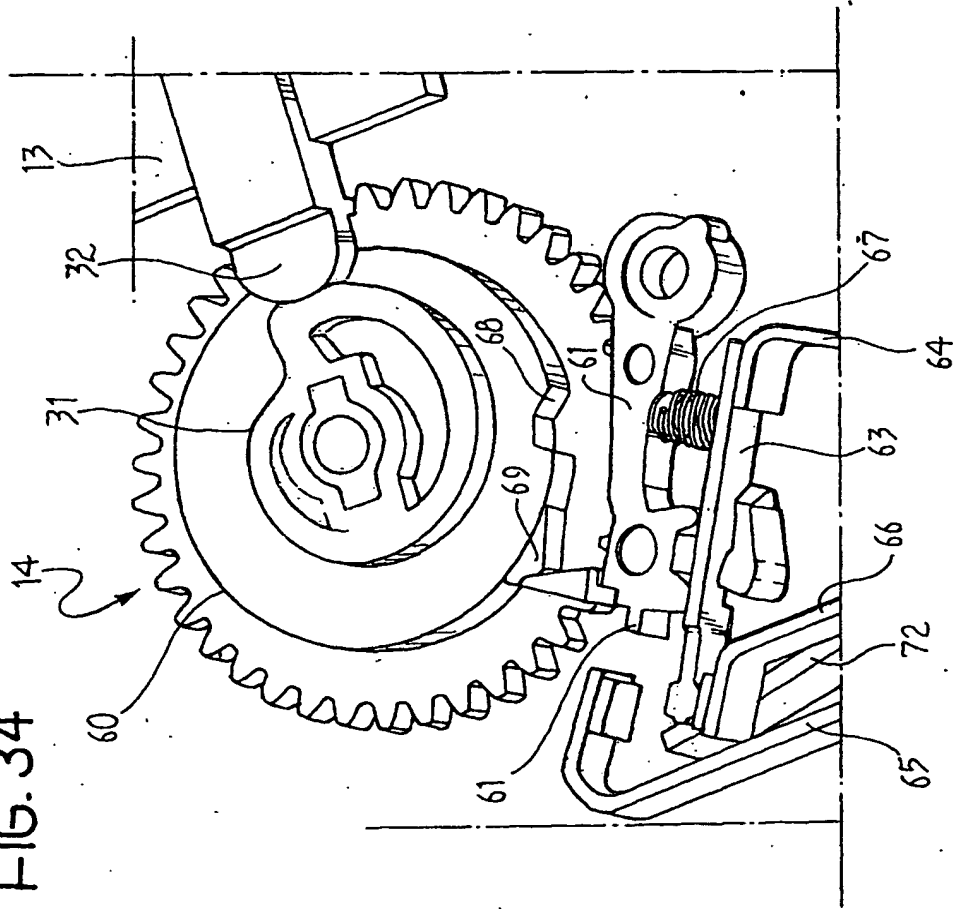


FIG. 35

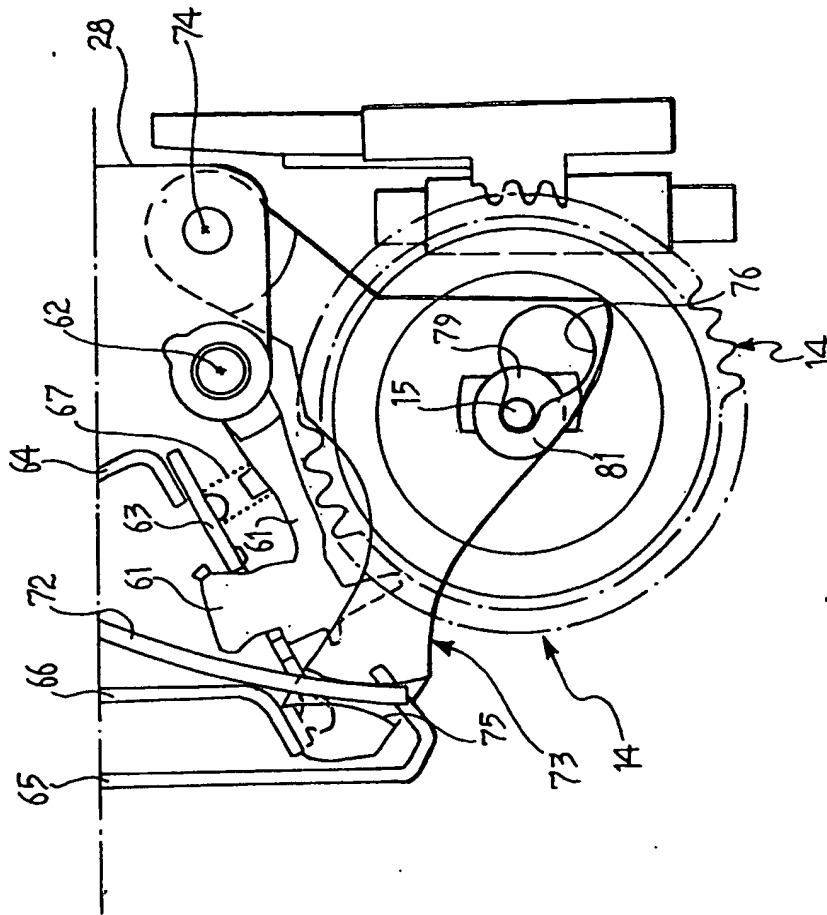


FIG. 36

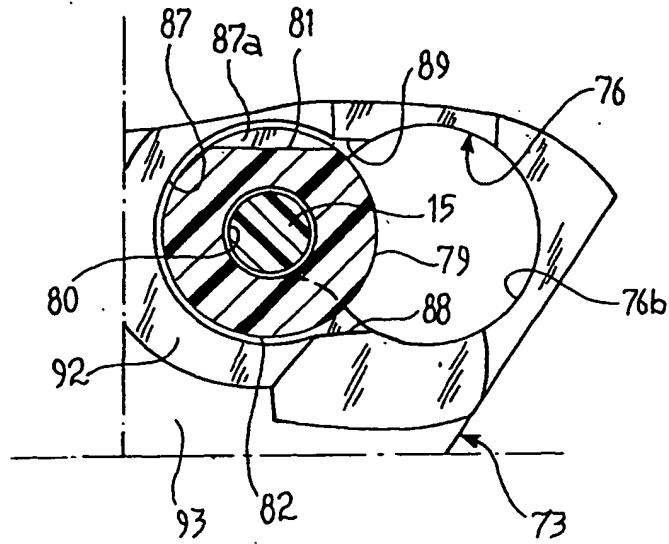


FIG. 38

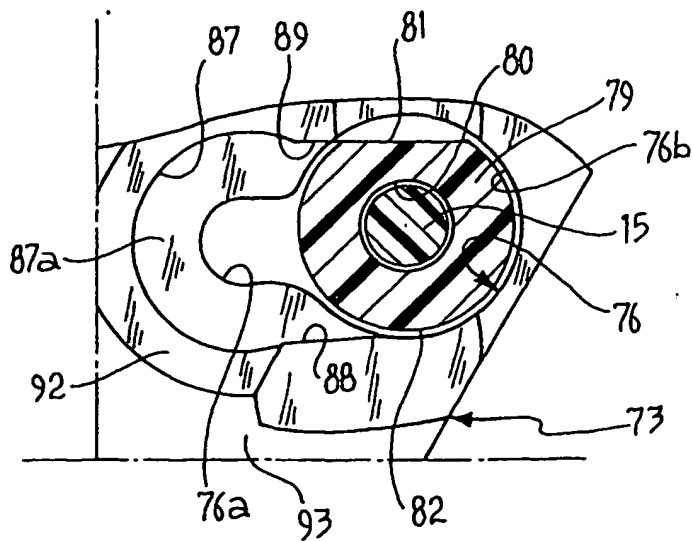




FIG. 37

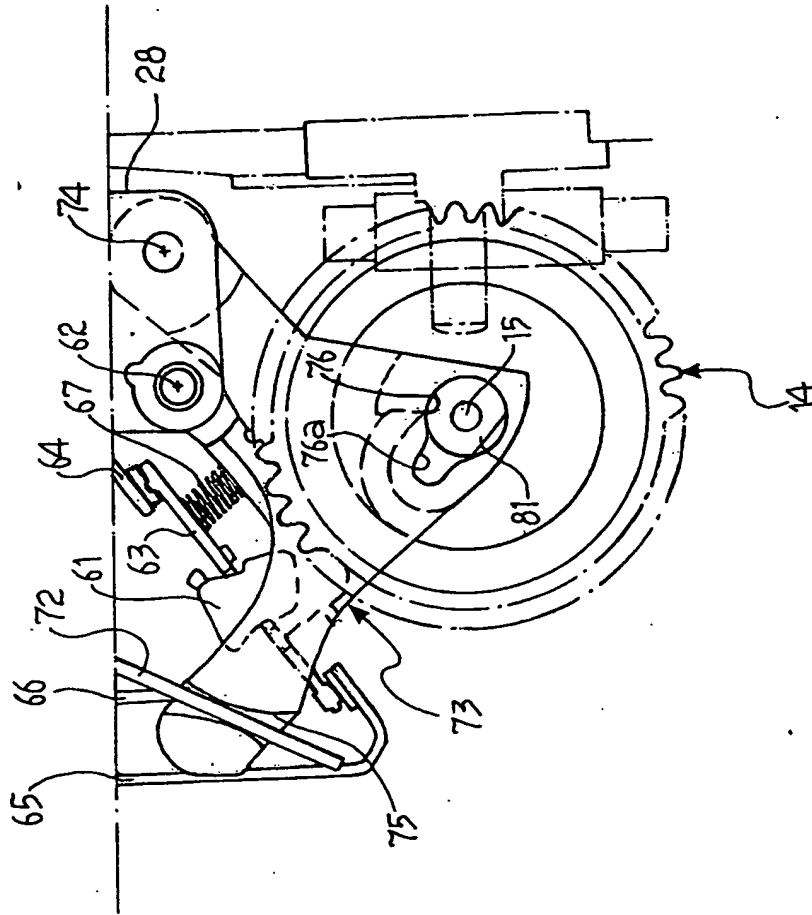


FIG. 39

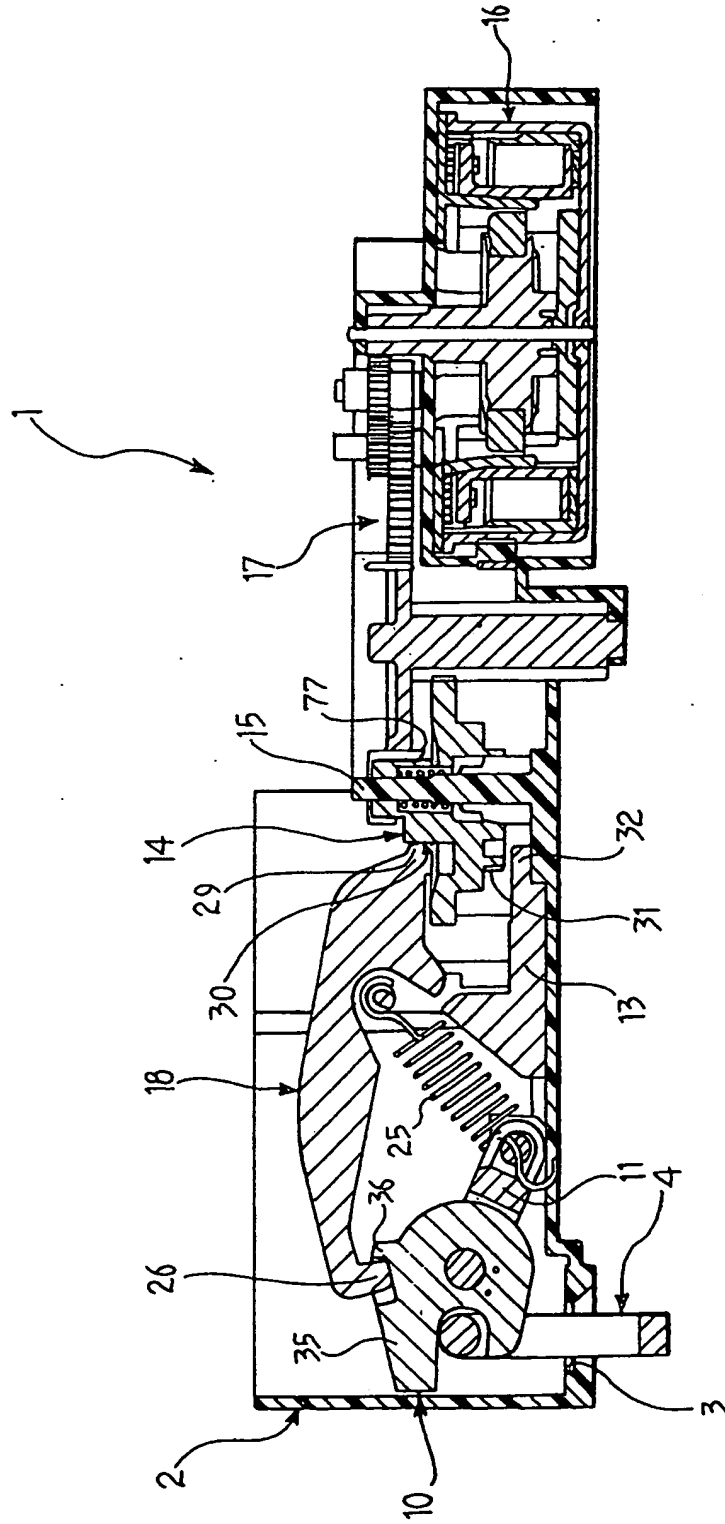


FIG. 40

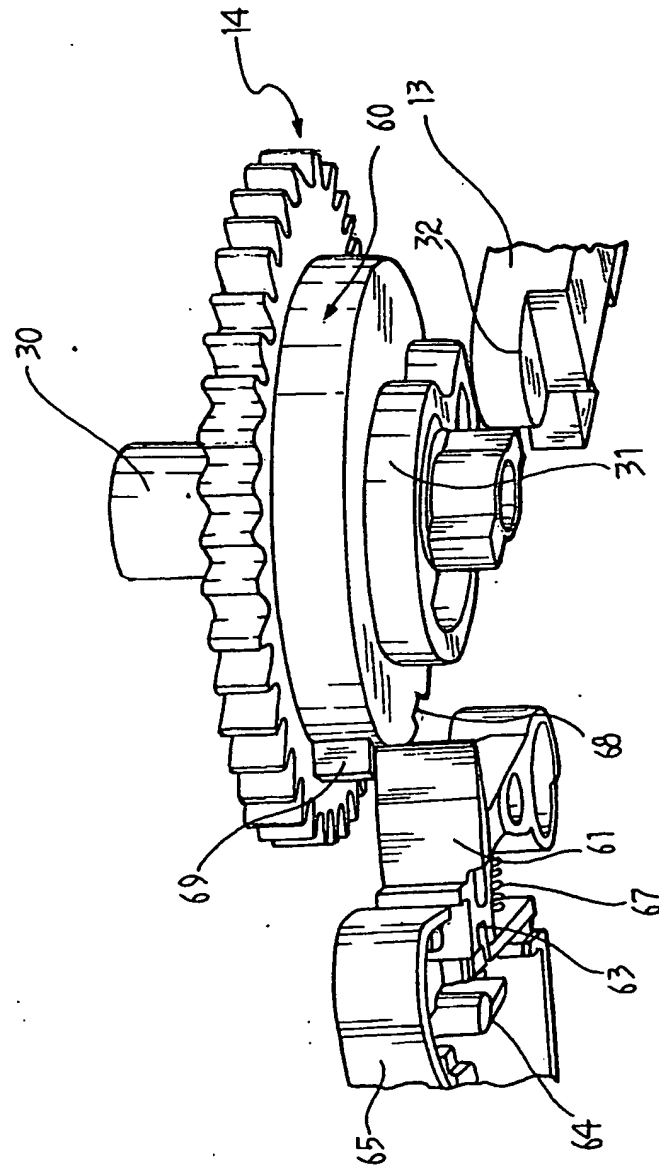


FIG. 41

